CONFERENCES-PAMPHLET Box
1926

TECHNICAL CONFERENCES

OF THE

EAST AFRICAN DEPENDENCIES

PROCEEDINGS OF THE SOUTH & EAST AFRICAN

COMBINED

AGRICULTURAL, COTTON, ENTOMOLOGICAL AND MYCOLOGICAL CONFERENCE

HELD AT

Nairobi, August, 1926.

PRINTED BY
THE EAST AFRICAN STANDARD, LTD.,
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INTER-COLONIA

Meeting of Cotton, Entomolo

Published by the courtesy of the "E. A. Farm and Home Journal."

FRONT ROW (left to right) : G. A. S. Northcote, E. J. Wortley (N.), Sgr. Bicch
Governor, A. Holm (K.), Miss Welsford (Z.), A. H. Kirby (T.)

SECOND ROW : A. D. le Poer Trench (K.), M. H. Fox (K.), P. Booth (K.), F. J
(P.E.A.), P. Koch (Union S.A.), E. F. Salter (E.C.G.C.), G. W
(Z.), G. S. Cameron (S. Rhodesia and E.C.G.C.), E. J. Waddin

BACK ROW : T. W. Kirkpatrick (K.), H. Wilkinson (K.), Senhor Grillo (P.E.A.
S. A. Pereira (M.), C. Smee (N.), H. Hargreaves (U)., H. C.

L CONFERENCE.

ical and Mycological Experts

Photo : LAWRIE.

ri (I.S.), S. Simpson (U.), C. Fuller (Union South Africa), His Excellency the Baron Surcouf (M.), S. Milligan (E.C.G.C.).

Sheedy (T.), F. F. Parnell (E.C.G.C.), C. Wood (E.C.G.C.), C. B. Hardenberg Nye (U.), Col. Walker (Secretary), Vanden Abeele (B. Congo), V. H. Kirkham on (Asst. Secretary).

J. Macdonald (K.), G. L. Burton (K.), A. H. Ritchie (T)., V. A. Beckley (K.), cker (E.C.G.C.), T. D. Maitland (U.), T. J. Anderson (K.).

COMPOSITION OF THE CONFERENCE.

PRESIDENT:

His Excellency Lt.-Col. Sir Edward Grigg, K.C.V.O., C.M.G., D.S.O., M.C.

CHAIRMAN:

Hon. G. A. S. Northcote, Acting Colonial Secretary, Kenya.

MEMBERS:

SOUTH AFRICA:

Mr. Claude Fuller (Assistant Chief, Division of Entomology).
Mr. Pieter Koch, B.Sc.Agr. (Principal Tobacco and Cotton Officer, Department of Agriculture).

SOUTHERN RHODESIA:

Mr. G. S. Cameron, M.C.*

KENYA:

Hon. Alexander Holm, C.B.E., F.H.A.S., M.R.A.S.E., S.E.A.C. (Dip Hons.) (Director of Agriculture, Kenya).
Mr. V. A. Beckley, M.C., M.A., A.I.C.
Mr. M. H. Fox, B.Sc. A.I.C.
Mr. T. J. Anderson, M.A., B.Sc., F.Z.S., F.E.S.
Mr. T. W. Kirkpatrick, B.A., F.E.S.
Mr. H. Wilkinson, A.R.C.S., F.E.S., F.L.S.
Mr. J. McDonald, D.F.C., B.Sc., F.L.S.
Mr. P. Booth, N.D.A., U.D.A.
Mr. A. G. Bailey, B.A.
Mr. G. J. L. Burton, M.C., B.A.
Mr. A. D. le Poer Trench (Dip. O.A.C.)

NYASALAND:

Mr. E. J. Wortley (Director of Agriculture, Nyasaland).
Mr. C. Smee, M.C., A.R.C.S., D.I.C., F.E.S.

TANGANYIKA:

Mr. A. H. Kirby, B.A. (Director of Agriculture, Tanganyika).
Mr. A. H. Ritchie.
Capt. F. J. Sheedy, M.B.E., B.Sc., M.R.C.V.S.

UGANDA:

Hon. S. Simpson, C.M.G. B.Sc., M.R.A.S.E., N.D.A. (Director of Agriculture, Uganda).
Mr. T. D. Maitland, M.B.E.
Mr. H. Hargreaves, A.R.C.S., D.I.C., F.E.S.
Mr. G. W. Nye, B.Sc. (Lond.), Dip.Ag. (Wye).

ZANZIBAR:

Hon. V. H. Kirkham, F.I.C., B.Sc. (Lond.), Dip.Agric. (Camb.)
Miss E. J. Welsford, M.B.E., F.L.S.

EMPIRE COTTON GROWING CORPORATION:

Mr. S. Milligan (South Africa).
Mr. F. R. Parnell (South Africa).
Mr. G. S. Cameron, M.C.* (Southern Rhodesia).
Mr. E. F. Salter (Northern Rhodesia).
Mr. H. C. Ducker, B.Sc. N.D.A. (Nyasaland).
Mr. R. C. Wood, M.A. (Swaziland).

* Mr. G. S. Cameron represented the Government of Southern Rhodesia and also the Empire Cotton Growing Corporation.

BELGIAN CONGO:
Monsieur Van den Abeele.

ITALIAN SOMALILAND:
Cavalieri Bicchieri.

PORTUGUESE EAST AFRICA:
Mr. C. B. Hardenberg, B.A., M.A.
Senhor F. Montiero Grillo, E.A., T.S.A.
Baron J. M. R. Surcouf, D.SC., L.A.S.P.
Senhor Luis de Sa Pereira, G.S.A.

SECRETARY:
Colonel C. W. G. Walker, D.S.O.
(Secretary, East African Governors' Conference.)

ASSISTANT SECRETARY:
Mr. E. J. Waddington, O.B.E.
(Asst. Secretary, East African Governors' Conference.)

CHAIRMEN OF SECTIONS:

Agricultural	Hon. Alex. Holm, C.B.E.
Cotton	Mr. S. Milligan.
Entomological and Mycological	Mr. Claude Fuller.

NOTE ON THE CONVENING OF THE CONFERENCE.

With the approval of the Secretary of State for the Colonies, the Kenya Government had, early in 1925, issued invitations to various Governments for an Agricultural Conference to be held in Nairobi during that year.

The East Africa Commission also favoured the idea of the holding of Technical Conferences, such as Agricultural or Cotton, with a view to achieving co-ordination and co-operation between the East African Territories.

Proposals were then made for Cotton and Entomological Conferences. The Secretary of State for the Colonies however suggested that the proposed Agricultural, Cotton and Entomological Conferences should be combined, and directed that the question should be further discussed at the Conference of Governors of the East African Dependencies, which was assembling in Nairobi in January and February, 1926. This was done, and, as a result of correspondence between the Governors' Conference and the Secretary of State with regard to the date most suitable to all the various interests concerned, the Secretary of State eventually fixed August, 1926, for the Combined Agricultural, Cotton, Entomological and Mycological Conference; he further directed that the Conference should be held in Nairobi; and instructed the Secretariat of the Conference of Governors of the East African Dependencies to make all the necessary arrangements.

PART I.

Opening Speeches Agenda and Programme.

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PART I.

OPENING SPEECHES, AGENDA AND PROGRAMME.

CHAPTER I.

OPENING SPEECHES.

The opening meeting was held in the Memorial Hall at 10-15 a.m. on August 17th, 1926.

HIS EXCELLENCY THE PRESIDENT, in opening the Conference, said:—

Gentlemen,—It gives me the very greatest pleasure to welcome you here to Kenya Colony and Protectorate, and I am only sorry that you are meeting for the first time on one of our greyest mornings. I hope, however, that the Kenya sun will come out and shine upon you on subsequent mornings. We are very proud indeed to have this Conference in Kenya and hope you will take away with you a good impression of the Colony.

This Conference is, I think, a very striking example of the growing belief which is manifest throughout the world at the present time in the value of co-ordinating agricultural research and of the increasing importance which is being attached to the scientific study of agricultural problems. It is a remarkable testimony to that growing belief that there are eleven governments represented at this Conference here to-day and that they stretch right up this side of Africa from South through Central Africa to Somaliland.

I am very glad that the Conference is now actually assembled for I know it has been very much in the thoughts of the present Secretary of State, Mr. Amery, for a long time past—in fact ever since he gave attention to Imperial affairs he has been deeply interested in Imperial agriculture. He was, after all, the pupil of Lord Milner and Lord Milner was, I think, the first leading British statesman to realise that the organised study of agriculture, the scientific study of agriculture, was one of the first of the Empire's needs.

Mr. Amery has, therefore, been most deeply interested in the Conference and has sent the following telegram:—

> Request you will convey to delegates of Agricultural Conference expression of my satisfaction that so representative an assembly has been possible and my conviction that their meeting will be of the greatest value in dealing with problems on which the prosperity of so many countries depends.

I suggest that a little later in the proceedings we should send a reply to the Secretary of State and also send certain other telegrams of greeting. I think I ought to say that we have also had messages from other Governments. The Government of South Africa forward their best wishes for the work and express the belief that the results will be of the greatest benefit to those territories, whose representatives are taking part. The Government of the Sudan express great regret that they are unable to send a representative and wish the Conference every success. The Government of the Seychelles has contributed a paper and much regrets not being able to send a delegate to read it but hopes much benefit will be derived from the discussions.

I should like on behalf of Kenya to give an especial welcome to the representatives here of Italy, Belgium, and Portugal. All these three countries were our old Allies in the war and all of them, I think, are facing responsibilities in this part of Africa which have been increased and enlarged by the war. (Hear, hear.) We are very glad, therefore, to have their close and friendly co-operation like this in the tasks of peace.

This Conference has been convened by the Secretary of State for the Colonies. It was suggested in its present form originally, I think, by the East African Commission which came out here in 1924 and which published such an excellent report. It was also favoured and strongly supported by the Governors' Conference which met here at the beginning of the present year and at that time, I think, arrangements were definitely made for it to be held; but the origin of the idea goes back a long way, to 1921. My friend, the Director of Agriculture for Kenya, was the first to suggest one side for it, the agricultural side, and from other quarters came suggestions for a cotton conference and for entomological and mycological conferences. Very happily these three conferences have been combined and, as you know, you will be dealing with joint problems covered by all three subjects during sittings here.

I should like to say also how much we appreciate the co-operation of the British Empire Cotton Growing Corporation which has sent five representatives, the senior of whom is Mr. Milligan, well-known in all matters pertaining to cotton and agriculture. I know that Kenya does not offer cotton much prospect or hope, but the Colony is deeply interested in cotton notwithstanding the fact that little cotton is grown here, because the railway which serves Kenya is a railway to which cotton is of the greatest importance; and whilst we are not able to do much to grow cotton ourselves we are anxious to see it thriving in Uganda and elsewhere.

The regions which the representatives of the different governments here represent are potentially immensely rich. I suppose that this is the greatest untouched reserve in the world. And it is only in the present century that people have realised its possibilities. From the dawn of history explorers have come to this country and perhaps some of the old civilisations have pushed their way down into the interior for a time, but practically speaking only the coast line and the fringe had been touched until the era of great development began some thirty years ago. From those hidden resources the veil has now been lifted and great discoveries are being made. There is already beginning to bear upon East Africa the full weight of the great world demand for further production which is one of the greatest features of our time.

It is not only that the population of the world is increasing, but that the standard of life is rising generally everywhere and that all the peoples of the world are requiring more and more of the fruits of the earth if they are to expand or even maintain their standard of life and their industries. The economic pressure that results from that demand is an immeasurable force and that is the force with which we have to deal here in East Africa at the present time.

That mighty force creates one of the greatest political problems in history. I am not going to speak about that now except to say this, that the political problem would be insoluble without the help of the scientific study which you represent. There is an extraordinary range of products obtainable from these regions. There is a wide range of animal products, grains, pulses, oil seeds, fibres for textile industries, rubber, fruit, all connected with the agricultural industry of the countries represented at this Conference. Which of these things are we to concentrate on most and how are we to proceed with the production of the best crops? How are we to deal moreover with some of the features of the agricultural problem here, where there is not only great wealth of soil but a great wealth of pests? In all these things we want your help in research and investigation.

The study of applied agriculture has been for years carried on in rather a sporadic and unco-ordinated and piecemeal fashion; and it is only in the present century that it has really come to be organised. Looking back on it, it reminds me a little of the history of the humanities, scholarship and learning after the fall of the Roman Empire. During the dark ages when human learning was at a very low ebb, scholars, single scholars were travelling through the darkness feeling themselves very much alone and lifting weak and tremulous lamps to try and illumine the shadows about them. But as you know, after the dark ages came one of those extraordinary changes in history. The sky turned grey and light began to spread. The lonely workers discovered that they were not alone; scholar held out hand to scholar; the pursuit of knowledge at last was organised. Great universities were founded and from that time the pursuit of learning went on like a great army on the march with all its accoutrements glinting in the sun. That is something like the history of the study of agriculture in the last two generations. It has made astonishing progress in the present century. Research is being co-ordinated and organized, and it owes its present progress in the Empire to one man more than any other, Lord Milner. To his name I pay tribute to-day. No man would have welcomed so gladly the Conference assembled here as Lord Milner, who was one of the great pioneers of agricultural study and research in the Empire.

I am glad to know that the Imperial College of Tropical Agriculture in Trinidad is making progress with the scholarship scheme in which we participate. I am also glad to know that in the heart of the Empire, in London, there is now set up a system parallel to the Committee of Imperial Defence, the great Committee of Civil Research, to co-ordinate the investigation and study of all the great problems of normal life. Lord Balfour, who is the leading spirit of that Committee at the present time, is not only a statesman of unrivalled experience but is a man of science and philosophy, and I believe under his broad and fertile mind that Committee is going to perform the greatest services to the Colonial Empire. I can say on behalf of

Kenya that it has already helped us in a practical way. We are looking forward very much to the further help it will give us and we are most anxious to co-operate with it in every way so far as our means will permit. I think I am speaking on behalf of all representatives here when I say we look forward to the reconstitution and reorganisation of Amani. It is now in the hands of the Secretary of State and I hope it will be brought to life again and expanded before very long.

I must not keep you by talking too long and will end by telling you again that Kenya is very proud to have this Conference held here and hopes that the arrangements made for your comfort and convenience are agreeable to you. There is no doubt that this Conference will be a thing of pleasure and profit to us. We also hope it will be a thing of pleasure and profit to you delegates who have come from such great distances and also to the great scientific movement which you represent. (Applause.)

A vote of thanks to His Excellency was moved by Mr. Fuller (Union of South Africa) and seconded by Cav. L. Bicchieri, Royal Italian Consul.

Mr. FULLER:

On behalf of the delegates of this important Conference, and particularly for those amongst us from the Dominion of South Africa, I desire to thank you, Sir, for the very kind and warm welcome you have extended to us. Most especially, Sir, have I to thank you for the encouraging words with which you have set us to our various tasks and for your clear and helpful exposition of the duties that lie before us.

I feel sure this Conference will mark another milestone in the progress of Africa—Africa the great, the wonderful, but no longer the dark—another step, Sir, in the conquest of its wilds and its ills by the sons of Europe.

The honour of making this opening reply to your Excellency's welcome I gladly accepted on behalf of South Africa—South Africa whose future and destiny rests in safety upon that sure foundation—the love of the land by its farmers, be they Britain or Boer. We South Africans are all inordinately proud of the progress our community has made in the development of its agricultural resources. We point to it with pride and we tell one another and the world that with us agriculture has progressed by leaps and bounds. But how, Sir, shall I describe the amazing progress of agriculture in Kenya Colony? To me, at least, its progress in this glorious country has been phenomenal.

Many people have been so good as to refer in eulogistic terms to the strength and the organisation of the Agricultural Department of the Southern Dominion. I accept what they say " to the foot of the letter." Our Agricultural Department is what it is, and its influence throughout our land is what it is, because of the courage and prevision of one or two men, and one of these men is to be found to-day presiding over and directing the agricultural destiny of Kenya.

On behalf of all the delegates attending this Conference, but especially on behalf of those representing British Territories, I thank you, Sir, for your very kind welcome to us, and I ask the Cavalieri Bicchieri to add a few words on behalf of the delegates from other Territories.

CAV. L. BICCHIERI: Your Excellency; my honourable colleagues representing colonies other than those forming part of the British Empire, with that stately distinction which characterises them, have been pleased to assign to me the honoured task of replying to Your Excellency. I desire on their behalf as well as on my own, to express our sincere gratitude for the hospitality offered to us and for the arrangements made for our comfort. And it is with a spirit and heart sincerely moved that I address your Excellency the Governor of this Colony and President of this Conference, not only to convey to you our most cordial thanks in return for your expressions of welcome, but also for all you have done to help this Conference, both for its organisation and its future development.

We promise you that in this Conference nothing will be left unattempted which can help to stamp out the most common parasites and disease that tend to destroy plants, stocks, and crops in general. We shall also extend our best efforts to further good inter-colonial relationships and science and the prosperity of those colonies which are actively interested in the matters before this Conference. The spirit of solid organisation and co-operation always alive in this country for the attainment of an object near its heart I notice with gratification is also present on this occasion. Your Excellency's words, full of warmth and encouragement and confidence to this nascent Conference, cannot but spur us to attain really satisfactory results.

To Kenya I feel there will belong to-morrow the great glory of being the first to give life to a combined agricultural, cotton, and entomological conference, destined to become a creative centre which will radiate vital forces for the production and development of the great natural resources of the immense tracts of Africa.

Your Excellency, it gives me great pleasure to return thanks to you for your great kindness in coming from Mombasa especially to open this Conference, for your very kind and encouraging remarks contained in the speech you have just made when you declared the Conference open.

I also wish to thank the Secretary, Colonel Walker, for the excellent arrangements made for the general conduct of the business of the Conference.

His Excellency, on the conclusion of Cavalieri L. Bicchieri's speech, was introduced individually to each of the delegates.

The Conference then adjourned for a few minutes and a photograph was taken.

CHAPTER II.

ARRANGEMENTS FOR CONDUCT OF CONFERENCE.

HIS EXCELLENCY, on the re-assembly of the Conference, said that he thought the first task of the Conference should be to send a telegram of greeting to His Majesty the King and to the rulers of the other territories represented at the Conference: he then read to the Conference a draft telgram to Their Majesties the King and Queen.

The Conference unanimously approved the terms of this telegram which were as follows:—

> " Delegates of the Union of South Africa, Southern Rhodesia, British East African Dependencies, and Empire Cotton Growing Corporation now assembled for a Combined Agricultural, Cotton, Entomological, and Mycological Conference in Nairobi, submit their humble duty to H.M. the King and H.M. the Queen, and, together with the representatives of the Belgian Congo, Italian Somaliland, Mozambique, and Portuguese East Africa, desire to tender respectful greetings to Their Majesties. They trust that this Combined Conference may be of value to the people of the various territories in Africa represented."

His Excellency then suggested that instead of sending individual telegrams to the rulers of the other territories represented, it would be better, in accordance with the customary procedure, to ask the Secretary of State to forward telegrams of greeting to H.M. the King of Italy, H.M. the King of the Belgians, and the President of the Portuguese Republic.

The Conference unanimously adopted this proposal.

His Excellency made reference to the telegram from the Secretary of State to which he had referred in his Opening Speech, which was to the following effect:—

> " 10th August. Request you will convey to delegates of Agricultural Conference expression of my satisfaction that so representative an assembly has been possible and my conviction that their meeting will be of the greatest value in dealing with problems on which prosperity of so many countries depends.
>
> SECRETARY OF STATE."

Proceeding, he read to the Conference a suggested draft reply, as follows:—

> " The delegates of the Agricultural Conference now assembled in Nairobi tender their thanks for your telegram of good wishes and unanimously desire to express their appreciation of your assistance in bringing together so representative a gathering. They hope that their labours may benefit the peoples and enlarge the agricultural production of all the countries from which they come."

The Conference unanimously agreed on the terms of this reply.

His Excellency, continuing, said that he had a few suggestions to put forward as regards the arrangements to be made for the conduct of the Conference.

To commence a Conference such as this something was necessary for a start, and it was this which he proposed. The eventual lines on which the Conference worked could only be decided by the members themselves.

At the beginning of this year, when the Conference of Governors of the East African Dependencies had held their meetings, it had been agreed to recommend that a permanent Secretariat for the Governors' Conference should be located in Nairobi and that this Secretariat should not only be used for Conferences of Governors, but also for Technical Conferences such as the one now assembled. This proposal had been approved by the Secretary of State and the Secretariat was now a working institution. As the delegates were probably aware, the preliminary arrangements for the present combined Conference had been made by it.

The original letters circulated had suggested that the Conference to begin with should be divided into three sections; a tentative agenda on these lines had been circulated and the proposal had been generally accepted by the Governments concerned. He suggested, therefore, that, unless the various members had other suggestions to put forward, work should start in three sections: one dealing with Agriculture, one with Cotton, and a third dealing with Entomology and Mycology.

As regards the Chairmen of these sections, he suggested that the Chairman of the Agricultural Section should be the Hon. Alexander Holm, C.B.E., Director of Agriculture, Kenya; the Chairman of the Cotton Section should be Mr. Milligan, the senior representative of the Empire Cotton Growing Corporation; and the Chairman of the Entomological and Mycological Section should be Mr. Fuller, the senior representative of the Union of South Africa, provided that these gentlemen were ready to accept the work.

Messrs. Holm, Milligan, and Fuller said that they were ready to accept the Chairmanship of these sections.

His Excellency said that as the Conference agreed with his proposal for starting work in three sections under the Chairmen whom he had suggested, he thought it was best for the members of the Conference to divide themselves up amongst these sections, so that each member could attend for the items in which he was chiefly interested. He did not consider it possible to draw up a comprehensive programme of work for the whole Conference, owing to the large number of items which had been suggested for the agenda and owing to the impossibility of foreseeing how much time would be taken by the various items.

A programme for the first two days had already been circulated by the Secretary, which he thought should be adopted; for subsequent days it appeared best for the Chairmen of the three sections, after they had seen how they progressed with their preliminary work, to draw up their programmes for each day, arranging, when necessary, joint meetings of two sections.

As regards the records of the proceedings, he thought it would as a general rule be better that full stenographic notes should not be taken, but that Secretaries, including the Technical Secretaries who were being provided for the separate sections, should take notes and

dictate summaries of the remarks of the various delegates to stenographers, afterwards, allowing the delegates to whom remarks were attributed a chance at a later date to make such additions and amendments as they desired. In certain instances, especially if anyone wished to deliver a prepared statement on any of the items, then, of course, a stenographic note would be useful and could be taken; such arrangements could always be made by the various Chairmen, who would have full discretion in such matters.

The Conference unanimously adopted His Excellency's proposals and agreed that the various sections should start work on the items of the agenda already circulated at 9 a.m. on the succeeding day.

His Excellency said he had one further suggestion to make and that was that as the public were interested in this Conference it would be advisable for the Secretary to be given discretion to make communications from time to time to the Press.

The Conference unanimously adopted this proposal.

Subsequently work was started in sections, joint meetings being held when subjects of interest affecting more than one particular section were being discussed.

In order that the subsequent proceedings may be the more easily followed, they have been divided up into four parts:—

AGRICULTURE.
COTTON.
ENTOMOLOGY AND MYCOLOGY.
GENERAL.

Remarks have been added against the various items in these four Parts, showing whether they were discussed by one or more Sections. After Part V., General, appears a Summary of the more important Conclusions and Recommendations which were adopted by the whole Conference and also the concluding speech by the Chairman and the final Resolution.

With a view to making the daily work of the Sections of the Conference and the scope of the proceedings apparent, this chapter is followed immediately by the Agenda prepared for the whole Conference.

CHAPTER III.

AGENDA.

CATEGORY I.

GENERAL.

1. Review of Agriculture in Kenya.
(Paper by the Director of Agriculture, Kenya. T.C.(C)Ag.18).
(See page 247.)

2. Economic Progress of Tanganyika Territory.
(Paper by the Director of Agriculture, Tanganyika Territory. T.C.(C)Ag.10.)
(See page 259.)

3. Exchange of Information on Agricultural Subjects:—
(a) The establishment of an Agricultural Journal for East Africa.
(Paper by the Director of Agriculture, Kenya. T.C.(C)Ag.1.)
*(b) The desirability of reciprocal arrangements between the various Governments for the regular exchange of information, especially Government publications relating to Agriculture and the business of the farmer.
(Note by the Chief of the Division of Agricultural Economics, Union of South Africa. T.C.(C)Ag.2.)
*(c) Empire exchange of Agricultural literature and an East African Journal on Agriculture.
(Note by the Agricultural Department, Tanganyika Territory. T.C.(C)Ag.11.)
(See page 276.)

4. Amani Institute.
(a) The relation of the Amani Institute to local Departments of Agriculture.
(To be raised by the Director of Agriculture, Nyasaland.)
(b) Its direct and indirect use for Technical Agricultural Officers, with particular reference to Cotton.
(c) Its use as a means of liaison between Cotton investigators in East Africa.
(To be raised by the Director of Agriculture, Tanganyika Territory.)
(See page 277.)

5. Legislative Measures in the Control of Insect Pests and Plant Disease.
(Paper by T. J. Anderson, Entomologist, Kenya. T.C.(C)E.&M.1.)
(See page 226.)

6. The adoption of a definite scheme of co-operation between the Departments of Agriculture in East and South Africa.
(To be raised by the Director of Agriculture, Nyasaland.)
(See page 275.)

* These items were subsequently withdrawn from the Agenda in view of the discussion on item 3(a) above.

7. Government Control of Marketing.
(Note by Chief of the Division of Agricultural Economics, Union of South Africa. T.C.(C)Ag.19.)
(See page 268.)

8. Game: Preservation or Destruction.
(Note by the Agricultural Department, Tanganyika Territory. T.C.(C)Ag..15)
(See page 266.)

9. Metric System.
(Note by Mons. Vanden Abeele, Belgian Congo. T.C.(C)Ag.22.)
(See page 265.)

10. Consideration of proposal to hold an Agricultural Show representative of East Africa at Nairobi about July, 1927.
(To be raised by the Director of Agriculture, Kenya.)
(See page 264.)

11. The Control of the Native Cotton Industry and how far the Regulations in force for such control in the several Countries represented are practical and adequate.
(Paper by H. C. Sampson, Empire Cotton Growing Corporation. T.C.(C)Cot.1.)
(See page 183.)

12. The Consideration of the Question of the Movements of Cotton, Seed Cotton and Seed from one Territory to another.
(Paper by H. C. Sampson, Empire Cotton Growing Corporation. T.C.(C)Cot.2.)
(See page 183.)

13. The Cotton Industry in Uganda.
(Paper to be read by Director of Agriculture, Uganda.)
(See page 130.)

14. The Printing and Publication of the Report.
(See page 281.)

CATEGORY II.

AGRICULTURE.

1. Some Soil Problems in Kenya.
(Paper by V. A. Beckley, Agricultural Chemist, Kenya. T.C.(C)Ag.8.)
(See page 30.)

2. The Economics of Industrial Alcohol Manufacture from Agricultural Products.
(Paper by M. H. Fox, Chemical Officer, Kenya. T.C.(C)Ag.7.)
(See page 40.)

3. Registration of Cattle.
(Paper by Mons. Vanden Abeele, Belgian Congo. T.C.(C).Ag.21.)
(See page 65.)

4. Adulteration of Farm Products and Methods of Prevention other than Compulsory Inspection and Grading.
(Note by the Agricultural Department, Tanganyika Territory. T.C.(C.)Ag.9.)
(See page 107.)

Additional Items.

The items given below have been added at the request of the different Governments so that information with regard to them may be forthcoming; an informal discussion will probably be of value. No formal papers dealing with these questions have been circulated, but it is presumed that representatives of the Governments concerned will explain exactly what information they wish to obtain from the other members of the Conference.

5. Tobacco growing by Natives and its development as an industry, especially as regards Nyasaland.
(Asked by the Agricultural Department, Uganda.)
(See page 92.)

6. The cost of producing one gallon of milk and one lb. of butter fat:—
(a) from grass feeding (grazing) only;
(b) from grass feeding plus hand feeding (hay meal, etc.).
(Asked by the Agricultural Department, Union of South Africa.)
(See page 66.)

7. The Chief Agricultural Products for which a satisfactory market could be developed in East African Territories.
(Asked by the Agricultural Department, Union of South Africa.)
(See page 109.)

*8. Most effective methods adopted in Kenya for pruning coffee.
(Asked by the Agricultural Department, Portuguese East Africa.)

9. The Meat Industry:—
(a) Cost of production of average five-year-old steer and average weight;
(b) The maximum price of land for profitable ranching;
(c) The average carrying capacity of grazing land;
(d) From where pedigree stock is chiefly imported. What rebates (if any) are allowed for transportation (inland and ocean).
(Asked by the Agricultural Department, Union of South Africa.)
(See page 66.)

* This item was subsequently withdrawn from the Agenda as the representatives of Portuguese East Africa after visits to coffee farms and practical demonstrations of pruning considered the question answered.

10. Policies of Northern Rhodesia and Nyasaland in regard to European settlement; methods adopted; terms on which land is allotted; form and extent of Government assistance; results; settler population in 1913 and 1925.
(Asked by the Agricultural Department, Tanganyika Territory.)
(See page 110.)

11. The attitude of the different Agricultural Departments in regard to compulsory dipping of cattle by natives.
(Asked by the Agricultural Department, Belgian Congo.)
(See page 69.)

12. Wheat cultivation by Natives.
(Asked by the Agricultural Department, Belgian Congo.)
(See page 95.)

*13. Shade for Coffee.
(Asked by the Agricultural Department, Belgian Congo.)

* This item was subsequently withdrawn from the Agenda at the request of the representative of the Belgian Congo who considered the question answered after a visit to coffee farms in the neighbourhood of Nairobi where the matter was discussed.

CATEGORY III.

COTTON.

1. Seed Improvement:—
(a) Methods of testing new or improved strains of Cotton in different parts of the country.
(Paper by H. C. Sampson, Empire Cotton Growing Corporation. T.C.(C).Cot.4.)
(See page 143.)

(b) Methods of investigating possibilities of new varieties of Cotton.
(Paper by H. C. Sampson, Empire Cotton Growing Corporation. T.C.(C).Cot.5.)
(See page 143.)

(c) Selection: (i) plant to row (ii) mass.

(d) Methods adopted for rapid increase of seed supply from small samples.

(e) Value of accurate observations as regards growth curves, flowering curves and bolling curves; value of correlating above curves with meteorological returns; presentation and analysis of results.

(f) Value of crossing.
(To be raised by Agricultural Department, Uganda.)
(See page 144.)

2. Methods adopted to secure the purity of seed distributed for sowing purposes.
   (Paper by H. C. Sampson, Empire Cotton Growing Corporation. T.C.(C).Cot.6.)
   (See page 144.)

3. "Mass" Methods for maintaining the quality of Cotton Seed.
   (Paper by the Agricultural Department, Tanganyika Territory. T.C.(C).Cot.9.)
   (See page 152.)

4. Interchange of varieties and pureness of strain of Cotton for trial and observation in various African Territories.
   (Paper by the Agricultural Department, Southern Rhodesia.)
   (See page 144.)

5. The control of Ginneries, with special reference to the spread of disease.
   (Paper by H. C. Sampson, Empire Cotton Growing Corporation. T.C.(C).Cot.7.)
   (See page 183.)

Note.—The Agricultural Department, Belgian Congo, desire information on methods of control of Cotton Ginneries.

6. Yield improvement by means of field experiments.
   (To be raised by the Agricultural Department, Uganda.)
   (See page 144.)

7. A promising species of Wild Cotton in the Mozambique Company's Territory.
   (Paper by Baron Surcouf of the Mozambique Company's Territory. T.C.(C).Cot.13.)
   (See page 156.)

8. Native Cotton Industry in the Territory of the Mozambique Company.
   (Paper by Senhor L. de Sa Pereira, Cotton Expert of the Mozambique Company. T.C.(C).Cot.14.)
   (See page 137.)

CATEGORY IV.

ENTOMOLOGY AND MYCOLOGY.

1. Biological control of Insect pests, with particular reference to the control of the common Coffee Mealy Bug in Kenya Colony.
   (Paper by T. W. Kirkpatrick, Assistant Entomologist, Kenya. T.C.(C)E. & M.2.)
   (See page 184.)

2. Some factors influencing the occurrence and distribution of Plant diseases in Kenya.
   (Paper by J. McDonald, Mycologist, Kenya. T.C.(C)E. & M.3.)
   (See page 214.)

3. Note on species of Platyedra occurring in Uganda.
(Paper by G. L. R. Hancock, Assistant Entomologist, Uganda. T.C.(C)E. & M.4.)
(See page 228.)

4. Lycidocoris Mimeticus R. & P. (Capsidæ)—a potential pest of Coffee.
(Paper by H. Hargreaves, Entomologist, Uganda. T.C.(C)E. & M.5.)
(See page 196.)

*5. Biological investigations on Glossina Morsitans, and its Trypanosomes.
(Paper by Baron Surcouf. T.C.(C)E. & M.6.)

6. On Apion Armipes and its destruction by a natural parasite.
(Paper by Baron Surcouf of Mozambique Company's Territory. T.C.(C)E. & M.7.)
(See page 233.)

* This item was subsequently withdrawn from the Agenda as Baron Surcouf, who had raised it, was proceeding after the Conference to Entebbe, where he would have an opportunity of discussing it with the International Sleeping Sickness Commission.

Additional Items.

The items given below have been added at the request of the different Governments so that information with regard to them may be forthcoming; an informal discussion will probably be of value. No formal papers dealing with those questions have been circulated, but it is presumed that representatives of the Governments concerned will explain exactly what information they wish to obtain from the other members of the Conference.

7. Most effective methods adopted in Kenya for combating:—
(a) Coffee stem borer. *(See page 204.)*
(b) Leaf disease. *(See page 201.)*
(Asked by the Agricultural Department, Portuguese East Africa.)

8. The extent of Gummosis in Coconuts on the Mainland; its cause and control.
(Asked by the Agricultural Department, Zanzibar.)
(See page 205.)

9. Legislative Measures.
†(a) International regulations and arrangements for the import of plants—administration of plant import regulations.
(Asked by the Agricultural Department, Kenya.)
(b) Measures suggested for the prevention of spread of plant diseases.
(Note by the Agricultural Department, Belgian Congo. T.C.(C)Ag.20.)
(See page 225.)

† This item was subsequently withdrawn from the Agenda as it was covered by the discussion on Item 5, Category I., General.

10. Control of Streak Disease—Maize and Sugar Cane.
(Asked by the Agricultural Department, Kenya. Information especially requested from South Africa.)
(See page 212.)

11. New information re Sugar Mosaic Disease.
(Asked by the Agricultural Department, Kenya. Information especially requested from South Africa.)
(See page 213.)

12. Heat injury of Sisal Leaves after cutting. (i)
(Asked by the Agricultural Department, Kenya. Information especially requested from Tanganyika Territory.)

13. Rosette Disease of Ground Nuts.
(Asked by the Agricultural Department, Kenya. Information especially requested from South Africa.)
(See page 213.)

14. The Control of Termites, more especially the work done in the Union of South Africa, with regard to control in buildings. (ii.)
(Asked by the Agricultural Department, Kenya.)

15. Recent work in the control of Cutworms.
(Asked by the Agricultural Department, Kenya.)
(See page 220.)

16. Lists of the injurious insects of the various territories with their food plants and status as pests, with a view to compiling as complete a list as possible for the Continent.
(Asked by the Agricultural Department, Kenya.)
(See page 220.)

17. Bacterium Malvacearum E.F.S. The nature and extent of the damage done by this disease, and best methods of control under conditions of native agriculture.
(Asked by the Agricultural Department, Uganda.)
(See page 220.)

18. Brown Bast Disease of Hevea. The most effective and economical method of control.
(Asked by the Agricultural Department, Uganda.)
(See page 220.)

19. Measures other than hand-picking found practicable for control of Antestia Lineaticollis on Coffee.
(Asked by the Agricultural Department, Uganda.)
(See page 199.)

20. The use of local indigenous plants as insecticides and fungicides.
(Asked by the Agricultural Department, Nyasaland.)
(See page 222.)

21. Recent work on the control of Eelworms, particularly on Tobacco. (iii)
(Asked by the Agricultural Department, Nyasaland.)
(i) Subsequently withdrawn from the Agenda and discussed between representatives of Tanganyika and Kenya during a visit to the Sisal plantation at Thika.
(ii) Subsequently withdrawn from the Agenda and discussed unofficially between representatives of Kenya and South Africa.
(iii) Subsequently withdrawn from the Agenda at the request of the representative of Nyasaland.

22. The causes of die-back of Coffee.
(Asked by the Agricultural Department, Nyasaland.)
(See page 202.)

23. Rhinoceros Beetle and its control; the advisability of controlling by traps or other methods.
(Asked by the Agricultural Department, Zanzibar.)
(See page 210.)

24. Prevention of the introduction of the Codling Moth through imports of fresh fruit.
(To be raised by the Director of Agriculture, Kenya.)
(See page 223.)

25. Can information be given on the incidence of coffee leaf rust *(Hemileia vastatrix)* on Kents and Jacksons hybrid coffees and as compared with incidence on local types of *Co. arabica?*
(See page 200.)

26. What is the observed status of root eelworm *(Heterodera radicicola)* as a pest of coffee? Under what conditions is it most prevalent and what measures have been taken against it?
(See page 200.)

27. What is the status of *Gonocephalum simplex* or other species as pests (stem barking) of young coffee and what control measure has been recommended?
(See page 200.)

(Information on the above three items is asked by the Department of Agriculture, Tanganyika, from delegates of coffee producing countries at Conference.)

CATEGORY V.

AGRICULTURE AND COTTON.

1. Native Agriculture:
(a) Native Agriculture in Kenya, improvement, etc.
(Paper by E. Harrison, Deputy Director of Agriculture, Kenya. T.C.(C).Ag.3.)
(See page 71.)

Note.—The Agricultural Department, Belgian Congo, have asked for information on the organisation of Agricultural Schools for Natives in British Colonies.

(b) Mutual support and economic balance between Natives producing for external, and those producing for internal consumption.
(Paper by the Agricultural Department, Tanganyika Territory. T.C.(C).Ag.12.)
(See page 85.)

(c) The use of extended Native Administration for Agricultural progress.
(Paper by the Agricultural Department, Tanganyika Territory. T.C.(C).Ag.13.)
(See page 89.)

(d) Possibilities of co-operation among Natives in East Africa.
(Paper by the Agricultural Department, Tanganyika Territory. T.C.(C).Ag.14.)
(See page 91.)

NOTE.—The Tanganyika Government ask for information on efforts made to introduce Agricultural Co-operation among African Natives—in what branches of Agricultural activity and with what success.

2. TRANSPORT PROBLEM.
(Note by the Agricultural Department, Tanganyika Territory. T.C.(C).Ag.16.)
(See page 270.)

3. AN ORGANIZATION OF MARKETING IN A YOUNG COTTON INDUSTRY.
(Paper by the Agricultural Department, Tanganyika Territory. T.C.(C).Cot.8.)
(See page 127.)

4. CORRELATION OF WORK OF, AND CO-OPERATION BETWEEN, TECHNICAL SPECIALISTS AND GENERAL EXECUTIVE AGRICULTURAL OFFICERS.
(Paper by the Agricultural Department, Tanganyika Territory. T.C.(C).Cot.10.)
(See page 272.)

5. TEMPORARY EXCHANGE OF TECHNICAL SPECIALISTS BETWEEN DEPENDENCIES.
(Paper by the Agricultural Department, Tanganyika Territory. T.C.(C).Cot.11.)
(See page 272.)

Additional Items.

The items given below have been added at the request of the different Governments so that information with regard to them may be forthcoming; an informal discussion will probably be of value. No formal papers dealing with these questions have been circulated, but it is presumed that representatives of the Governments concerned will explain exactly what information they wish to obtain from the other members of the Conference.

6. DISCUSSION OF THE COTTON TAX, DEVISING A FAIR FORMULA THEREFOR.
(Asked by the Agricultural Department, Kenya; information desired from Uganda.)
(See page 138)

7. GRADING OF LINT.
(Asked by the Agricultural Department, Kenya; information desired from South Africa.)
(See page 139.)

CATEGORY VI.

AGRICULTURE, ENTOMOLOGY AND MYCOLOGY.

1. COFFEE:
   (a) Some aspects of Coffee Production in Kenya.
   (Paper by A. D. le Poer Trench, Senior Coffee Officer, Kenya. T.C.(C).Ag.4.)
   (See page 48.)

   (b) Coffee Robusta and its development in Uganda.
   (Paper by T. D. Maitland, Government Botanist, Uganda. T.C.(C).Ag.5.)
   (See page 56.)

2. THE CULTURE OF COCONUTS IN THE SEYCHELLES.
   (Paper contributed by the Director of Agriculture, Seychelles. T.C.(C).Ag.17.)
   (See page 211.)

3. SOME OF THE CEREALS IN KENYA COLONY WITH PARTICULAR REFERENCE TO WHEAT AND THE BREEDING OF SUITABLE VARIETIES THEREOF.
   (Paper by G. J. L. Burton, Plant Breeder, Kenya. T.C.(C).Ag.6.)
   (See page 96.)

4. METHODS OF STORAGE OF NATIVE FOOD PRODUCTS.
   (Asked by the Agricultural Department, Tanganyika Territory.)
   (See page 222.)

CATEGORY VII.

COTTON, ENTOMOLOGY AND MYCOLOGY.

1. NOTIFICATION REGARDING THE DISTRIBUTION, EXISTENCE, AND OCCURRENCE OF INSECT AND FUNGOID PESTS.
   (Paper by H. C. Sampson, Empire Cotton Corporation. T.C.(C)Cot.3.)
   (See page 221.)

2. ECONOMIC STATUS OF COTTON STAINER *(Dysdercus Spp.)*
   (Paper by the Agricultural Department, Southern Rhodesia. (T.C.(C)Cot15.)
   (See page 172.)

Additional Items.

The items given below have been added at the request of the different Governments, so that information with regard to them may be forthcoming; an informal discussion will probably be of value. No formal papers dealing with these questions have been circulated, but it is presumed that representatives of the Governments concerned will explain exactly what information they wish to obtain from the other members of the Conference.

3. THE DISTRIBUTION OF PINK BOLL WORM ON COTTON IN TANGANYIKA; measures adopted and with what success for control and prevention of spread of the pest.
   (Asked by the Agricultural Department, Uganda.)
   (See page 175.)

4. Natural occurrence of major pests in relation to:—
   (a) Flora.
   (b) Nature of the soil.
   (c) Climatic factors—altitude, distribution and amount of rainfall, temperature and humidity.
   (See page 179.)

5. Occurrence under conditions of cultivation:—
   (a) Effect of cultivation and implements.
   (b) Rotations.
   (c) Size of area under control.
   (See page 179.)

6. Bollworms: Value of control by:—
   (a) Natural enemies.
   (b) Elimination of food plants.
   (c) Implemental cultivation.
   (d) Rotations.
   (e) Spraying and dusting.
   (f) Trapping adults.
   (g) Hand-picking or collecting larvæ in the field.
   (h) Trap cropping.
   (i) Close season.

   Life Histories:—
   (a) Active period of insect.
   (b) Alternative food plants.
   (c) Range of flight of adults.
   (See page 174.)

7. Sudan Bollworm:—
   (a) General history in places where it is not considered of major importance.
   (b) Geographical distribution.
   (c) Wild food plants.
   (See page 177.)

8. Information of general interest in connection with such major pests as Pink Bollworm, Apion, etc.
   (See page 176.)

9. Internal Bollrot transmitted by stainers and other insects. (The Secretary for Agriculture, Union of South Africa, asked especially for information on this subject.) Value of control by:—
   (a) Natural enemies.
   (b) Elimination of food plants.
   (c) Trapping.
   (d) Hand-collecting.
   (See page 178.)

10. Aphids and Jassids: Value of control by:
   (a) Natural enemies.
   (b) Plant selection for resistance.
   (c) Spraying and dusting.
   (d) Cultivation.
   (See page 180.)

(All the above items have been raised by the Empire Cotton Growing Corporation.)

11. Whether the present methods of disinfection of Cotton Seed are adequate or not as a safeguard against the introduction of pests and diseases with imported Cotton Seed.

(Asked by the representative of Portuguese East Africa.)

(See page 177.)

CHAPTER IV.

PROGRAMME OF WORK OF CONFERENCE.

Tuesday, 17th August.

Morning:

Opening Speeches.
Discussion of mode of conduct of Conference.
Review of Agriculture in Kenya.

Afternoon:

Visit to Scott Laboratory.

Wednesday, 18th August.

Morning and Afternoon:

Work in Sections.
Agricultural Section discussed Items in Category II. of Agenda.
Cotton Section discussed Plant Breeding and Seed Distribution, including Items 1, 2, 4, and 6 of Category III. of Agenda.
Entomological and Mycological Section discussed Items of Category IV. of Agenda.

Thursday, 19th August.

Morning:

Sections continued discussions of preceding day.
Meeting of joint Agricultural and Entomological and Mycological Sections discussed Items of Category VI. of Agenda.

Afternoon:

Full meeting. Review of Economic Progress of Tanganyika Territory. Visit to Veterinary Laboratory, Kabete.

Friday, 20th August.

Morning:

Joint meeting between Agricultural and Cotton Sections discussed Items of Category V. of Agenda.
Entomological and Mycological Section discussed Items of Category IV. of Agenda, dealing with Coffee pests.

Afternoon:

Joint meeting of Agricultural and Cotton Sections discussed Cotton Industry in Uganda and South Africa.

Entomological and Mycological Sections continued work of the morning.

4 p.m. Conference visited Mr. Douglas' and other coffee farms.

SATURDAY, 21ST AUGUST.

Morning:

Joint meeting of Agricultural and Cotton Sections discussed Items of Category V. of Agenda.

Entomological and Mycological Section continued work of preceding day.

Afternoon:

Conference went to Nakuru.

SUNDAY, 22ND AUGUST.

Morning and Afternoon:

Conference inspected farms and methods of agriculture in the Nakuru neighbourhood.

MONDAY, 23RD AUGUST.

Conference returned from Nakuru to Nairobi.

TUESDAY, 24TH AUGUST.

Morning and Afternoon:

Joint meeting of Entomological and Mycological and Cotton Sections discussed cotton pests. (This meeting was also attended by certain members of the Agricultural Section.)

WEDNESDAY, 25TH AUGUST.

Morning:

Cotton Section reviewed work already accomplished on cotton questions.

Agricultural and Entomological and Mycological Sections discussed joint problems.

Afternoon:

Conference visited Limoru to see wattle factory, tea plantations, and native agriculture in the Reserves.

THURSDAY, 26TH AUGUST.

Morning:

Full meeting discussed items of Category I. of Agenda and items referred by individual Sections.

Afternoon:

Conference visited Thika neighbourhood to inspect sisal plantations and factories.

FRIDAY, 27TH AUGUST.

Morning:

Full meeting discussed items of Category I. of Agenda not previously dealt with.

Afternoon:

Full meeting discussed and confirmed Conclusions and Recommendations adopted by various Sections.

Closing Speech.

NOTE.—Remarks on the various visits are included in the appendix. See page 299.

PART II.

AGRICULTURE.

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PART II.
AGRICULTURE.

CHAPTER I. INTRODUCTORY.

The normal constitution of the Agricultural Section was as follows:

Mr. Alex. Holm (Chairman).....Director of Agriculture, Kenya.
Mons. Van den Abeele.....Agricultural Officer, Belgian Congo.
Mr. V. A. Beckley.....Agricultural Chemist, Kenya.
Cavalieri Bicchieri.....Royal Italian Consul, representing Italian Somaliland.
Mr. G. J. L. Burton.....Plant Breeder, Kenya.
Mr. A. H. Kirby.....Director of Agriculture, Tanganyika.
Mr. V. H. Kirkham.....Director of Agriculture, Zanzibar.
Mr. T. D. Maitland.....Botanist, Uganda.
Capt. F. J. Sheedy.....Acting Chief Veterinary Officer, Tanganyika.
Mr. S. Simpson.....Director of Agriculture, Uganda.
Mr. A. D. le Poer Trench.....Coffee Officer, Kenya.
Mr. E. J. Wortley.....Director of Agriculture, Nyasaland.

Technical Secretary ... Mr. V. A. Beckley.

Mr. A. Walter, Statistician to the Governors' Conference; Colonel A. G. Doherty, Chief Veterinary Officer, Kenya; Colonel R. B. Turner, Trade Commissioner for the Union of South Africa, also attended for discussions on certain items.

THE CHAIRMAN (Mr. Holm): " Gentlemen, before proceeding with the business of the Conference may I express to you, not only officially but personally, a welcome to Kenya and to the Offices of the Department of Agriculture. In ordinary circumstances, I should have wished to have prepared an address for this Section of the Conference, but it was not known until recently what were the arrangements for the Chairmanship of the various sections, and I hope under the circumstances that you will be disposed to regard the paper* which I read before the General Conference yesterday on ' Agriculture in Kenya ' as one appropriate for this Section. If there is anything contained in that paper which any member of this Section would wish to question before the Conference, I should be glad if you would do so, and I will deal with it to the best of my ability.

" With these preliminary remarks, I think we might ascertain the wishes of members with regard to the procedure of this Section. You will remember the President's remarks yesterday on the way he suggested the Conference should be conducted and which were generally accepted. I should explain that a few of us got together with a view to making tentative arrangements with regard to the business of the proceedings, and we came to the conclusion that each Section had better start to-day with those specific subjects which are peculiar to it and that later on joint and general meetings should take place. We came to the conclusion that, where certain subjects were to be discussed, two Sections should be combined; for example, Cotton and Agriculture, or Cotton and Entomology and Mycology, or again Agriculture with Entomology and Mycology. That is the way in

* For text see Part V., Chapter I.

which this Agenda, which is before you, was drawn up. It was further proposed that the Chairmen of the Sections should make a practice of meeting together at the end of each day's sitting to discuss and decide what subjects should be dealt with by each Section at its succeeding sitting, also those which should be reserved for the General Conference, so that there should be no unnecessary waste of time, and so that a programme could be arranged enabling those interested to attend discussions. Speaking generally, these were the proposals made, and I should be glad to know if they are acceptable to you; also, if you have any suggestions to offer for the work of the Agricultural Section."

These general arrangements, as outlined, were agreed to.

CHAPTER II. SOIL PROBLEMS.

SOME SOIL PROBLEMS IN KENYA.

Mr. BECKLEY read the following paper (referred to in the agenda as T.C.(C)Ag.8):—

Soil investigation in Kenya is a very young branch of scientific endeavour, and in this paper only the superficial aspects are considered. On the whole the soil problems of the Kenya Highlands are general in character but their application to any particular soil is intimately connected with the origin of that soil. A very great deal of the part of Kenya under European settlement is situated upon rock formations associated with the volcanic disturbances that accompanied the subsidences which have given rise to the Great Rift Valley. It is only with soils derived from these formations that it is proposed to deal as far as the fragmentary information regarding the geology of the Colony allows.

The Kapitian formation is the first of the lava flows. It forms the foundation of the Athi and Kapiti plains, and probably the greater part of the Uasin Gishu Plateau. It also appears in the neighbourhood of Mount Kenya and at Kisumu. The soil derived from this formation is a very dark coloured clay or clay-loam, generally spoken of as "black cotton soil." The vegetation carried by this class of soil is usually pure grass.

The Kapitian formation is overlain by the Doinyan basalts. As far as it has been possible to ascertain, the soils derived from this formation are sandy clays, light grey in colour when dry and black when wet. These soils are apparently poorly supplied with plant nutrients and are hungry soils.

The Nyassan formation, a mixture of lake deposits and small lava flows, has, so far, only been studied in the Rift Valley. The soils are silty in character. Later aeolian deposits have, to a large extent, covered the Nyassan soils, greatly modifying their nature. These soils, as far as it has been possible to characterise them, carry a mixed vegetation of thorn bush and grass.

The Laikipian lavas, which are the next in age, form the ridged lips of the Rift Valley and also occur in the neighbourhood of Mount Kenya. As their name infers, they form the Laikipia Plateau. In the more settled areas, the soils of the Kikuyu Highlands and those along the Mau and Elgeyo Escarpments are derived from this group of

lavas. These soils have a high clay content, but so wonderful is their crumb structure that they work like medium loams. Their original vegetation was forest but much has been cleared. Most of the coffee plantations are on this type of soil.

The Naivashan lavas in all probability give rise to much of the soil of the Trans-Nzoia. Unfortunately little is known of the geology of this area, but if Professor Gregory is correct in his estimate of the age of Mount Elgon, there can be no doubt but that much of this area is derived from this series. Little can be said regarding the soils of the Trans-Nzoia.

During the Pleistocene period the volcanoes of Longonot, Suswa, and Menengai, among others, were active. Ash and scoriæ from them covered the soils then in existence. In parts, this is especially marked on the upper slopes of Menengai and in the Kedong Valley, the particles of ash remain unchanged. Lower down the slopes of Menengai the character of the soil changes considerably. The fresh scoriæ disappear, the soil becomes more clayey and possesses a certain structure absent from the soil above. These modifications are probably due to admixture with the Nyassan series and the action of water weathering some of the finer ash particles to a colloidal condition. The vegetal relationships on the soils in this area are most interesting.

The mechanical composition of these soils has been considerably influenced by climatic conditions. In the more arid regions the original particles are hardly affected and the humus content of the soil is low. Where moister conditions have obtained, weathering changes have proceeded far with the formation of inorganic colloids, besides there has been a tendency for humus to collect. The soils of the drier parts are thus liable to pass into the single grain condition very readily under cultivation, where similarily derived soils containing more humus and fine fractions would retain their crumb structure longer.

There is a general idea that volcanic soils are extremely rich in all plant nutrients and that all the farmer has to do is to till the soil and plant his seed when wonderful crops will be returned indefinitely. It being being known that the soils of the Kenya Highlands are volcanic in origin, this idea had a great deal to do with the origin of the pernicious system of single crop farming practised, in which the farmer has kept his soil under the same crop continuously without the addition of any manure whatsoever. If it had been possible, not even the bare fallowing, that the climate has necessitated, would have been allowed. It has been noticed by some farmers, that the drop in crop production cannot be ascribed solely to the African scape-goat—decreasing rainfall. There was, they concluded, a lack of plant nutrients; manuring has followed.

The soils of Kenya, in common with the majority of African soils, are, on the whole, deficient in phosphates. Although it has not been possible, until recently, to conduct any manurial experiments, the use of phosphates has been widely recommended. Whereever such manuring has been practised good results have followed, but, so far, no reliable figures have been available. Nitrogen deficiency has been indicated in certain parts and crops have responded to dressings of nitrogenous manure. These deficiencies of nutrients are easily rectified. The deterioration in physical condition, that the farming practices in Kenya have, and are, causing will give more difficulty.

The coffee plantations are mainly situated on the soils derived from the Laikipian lavas. These have weathered into steeply sloped ridges upon which coffee has been planted. On such slopes the possibility of surface erosion is evident; however, in newly established plantations the danger is small. The soil possesses a wonderful crumb structure, which allows water to be absorbed most freely. Practically no water collects on the surface and, thus, there is practically no run off to cause wash. Unless kept cleanly cultivated coffee plantations are very readily overgrown by weeds. The continuous clean cultivation demanded breaks down the crumbs to a fine condition, rather like that of fine sand, which does not allow of rapid absorption of water. Surface water collects and wash becomes alarming.

It is of interest to note that, in native shambas, even though the slope may, and often is, greater than in most coffee shambas, the wash is negligible. Under native agriculture, the soil is forced to carry more than one crop; maize is inter-planted with pulse crops, sweet potatoes, and other low growing crops. Continuous cultivation is impossible and the mechanical destruction of the crumbs does not occur. Instead of removing or burning the crop residues, the greater part is dug into the soil, maintaining the supply of humus, which being freshly produced, re-cements the soil particles, encouraging the regeneration of the crumbs. In order to prevent wash on newly prepared slopes, stops of grass or rushes are placed across the slope. A system of green manuring, primitive it is true, is practised, the plant being a lush growing labiate.

These native methods of agriculture are not possible in coffee plantations or on other European farms. The intermingling of crops is not an economical practice. Other means of preventing wash have to be employed. The commonest of the methods consists in cultivating roughly along the contour lines so as to form shallow terraces on which the coffee grows, and in the planting of low growing plants as hedges across the slope. Neither of these methods can restore to the soil its highly absorbent nature, upon which the complete prevention of wash depends. The regeneration of the crumb structure is essential.

The cementing colloids in the Laikipian soils are ferric hydroxide and ferric humate. The first acts as a permanent cement and is probably derived from the latter. The particles are tenaciously cemented together, but when broken apart the re-cementation by ferric hydroxide per se is a very slow process. Humic acid, capable of forming ferric humate, is necessary to bring about the regeneration of the crumbs. Under the continuous cultivation the soils receive the aeration is most thorough; the greater part of the humus capable of reacting with the iron compounds of the soil has been oxidised and lost to the soil. The cultivations, necessary to keep the plantations free from weeds, at the same time are rapidly decreasing the water absorbing powers of the soil. It is essential, if wash is to be properly prevented, and the absorbent qualities improved, that organic manures, which will provide the fresh reacting humus, be used in conjunction with contour cultivation.

Another factor, that seems connected with the continuous cultivation in coffee plantations, is a decrease in the water retaining power. Soils that carried a heavy virgin growth of forest, now, under coffee, are unable to meet the water requirements of the crop. What the cause for this decrease may be is at present a matter of mere conjecture, and will early be made the subject of investigation.

But little is known of the soils derived from the Kapitian and Doinyan series. Both are heavy clays and are dark coloured. From a cursory examination it would appear that these soils are well supplied with organic matter. In the virgin state these soils are apt to crack badly but, under cultivation, the soils derived from the Kapitian lavas, and probably those of Doinyan origin, improve in condition, they lose their compactness and become mellow and friable. Observations on these soils under cultivation have not been continued long enough for data regarding their behaviour to be obtained.

The soils of the Rift Valley proper, derived from formations of varying age, are very interesting in their behaviour. The area around Nakuru has been under cultivation for a sufficient period for peculiarities in property to become marked. The soils vary considerably in character from sandy loams to silts and clay loams. The main crop, practically the only crop, has been maize year after year continuously. Ploughing and the various cultivations demanded by the growing of maize have been to the same depth season after season. In the sandy and silty soils a plough-sole pan has formed, which pan is overlain by a structureless soil apt to run into a hard surface after rain. The more clayey soils also form a pan but not so markedly as the lighter soils nor has the surface soil become broken down; at the same time the zone of wetness during which these soils can safely be tilled has become considerably reduced. On large farms, where it is impossible to complete the ploughing in a few days, this condition has made the preparation of a good seed bed extremely difficult, clodding has come to be regarded as a necessary evil.

In the system of farming practised the maize stalks are burnt in the field; weeds are likewise burnt. No, or at the best very little, organic matter is added to the soil in the form of crop residues with the result that the humus content has decreased considerably, leading to loss of structure. A rotation of crops, in which one crop would be used as green manure, is required, but, until it can be proved that such a rotation does not lead to a monetary loss, not over a period of years but over the period of the rotation, it will be extremely difficult to persuade farmers to follow a rotation. Another difficulty in this area is that pure arable farming only is practised; mixed farming is not suited to the conditions. Any minor crop grown in the rotation, in place of maize, would have to be saleable and to produce a nett return equal to that from maize. Such a crop is not easy to find; experiments are in progress.

The selection of green manure crops suitable for the two present two-staple crops, coffee and maize, are problems that give more difficulty than would be expected. For coffee a low growing non-climbing plant that can easily be controlled is required. Buckwheat is an admirable non-leguminous crop for such purposes; the selection of a legume is giving trouble. Sweet clover meets all the requirements, but on the coffee soils it fails, notwithstanding the fact that lucerne can be grown successfully. Careful examination of the roots of several species of *Melilotus* has failed to discover any plant carrying nodules. The pulse crops producing a heavy growth, such as cowpeas, the running beans, varieties of *Phascolus lunatus*, etc., are unsuited as green manures for coffee on account of their climbing propensities. Search has been made amongst the various erect native legumes.

Two indigenous crotalarias, *C. intermedia* and an as yet unnamed species, have proved most promising. These two species are very widely distributed, growing at all altitudes from 5,000 to 8,000 feet. so could be used in all coffee plantations. As compared to Sunn hemp both are heavier growers and more suitable for green manuring.

For maize and for wheat the problem would seem to be much simpler. An unexpected difficulty lies in the selectivity of the ordinary legumes to environment. For example, a variety of cowpea, that at an altitude of 5,800 feet, gave a yield of about a ton and a half of dry matter per acre, at an altitude of 6,600 feet on the same type of soil grew miserably, even though the plants had formed nodules. It is this selectivity that complicates the search for leguminous green manures; a legume may be the best for one altitude and fail at another not far removed.

The crotalarias, mentioned above, are suitable for a large range of conditions but very little seed is available; the growing seed forms the favourite food of the caterpillars of a group of blue butterflies. Many of the legumes widely used for green manurial purposes are badly attacked by disease and parasitical plants. Of eight varieties of cowpeas tried so far, two were sensitive to and completely destroyed by rust and a leaf disease, three produce much seed but little growth and thus unsuitable for green manuring, one is chlorotic while two are just suitable. Velvet beans are attacked by a leaf spot fungus and a species of *Orobanche*, besides not growing as strongly as some more resistant legumes.

Several species of Lupin, *Dolichos lablab*, *Phaseolus inamoenus*, certain species of Crotalaria and a cowpea obtained from the Embu district are, of the legumes tried, the most suitable. All of these will do well at altitudes from 4,000 to 6,000 feet, while the first two are suitable up to 7,500 feet. While ordinary string and runner beans and field peas do well at altitudes up to 9,000 feet, search is being made for a crop that will give heavier growth under these conditions. Arrangements are being made for the establishment of a group of trial plots at these greater elevations, those at the lesser have already been arranged, but it will require a little time before sufficient data can be obtained upon which to base recommendations.

Any strong growing plant, whether leguminous or not, will serve for the simple addition of humus to the soil. Certain attributes beyond mere growth are again necessary for the non-leguminous crop. The psychology of the farmer must be taken into account. If one of the ordinary cereals be sown and it promises to give a good crop, it is certain that it will never be treated as a manure. Many of the less usual crops, such as mustard, may be used but there is a danger of such a prolific seeder getting out of hand and becoming a weed. It is essential that the non-leguminous crop plant should not produce too valuable a crop, should not be too prolific a seeder, nor its seed be minute. Another desideratum is that it should grow rapidly and be capable of smothering weeds. Buckwheat appears to be one of the most suitable. It grows very rapidly, will smother weeds, occupies the soil for a short time, its seeds are not minute, and it is easily controlled.

That the weed problem is one to be considered seriously, is shown by the condition of some of the fields in the maize area, where quick seeding weeds, capable of seeding between the last cultivation the

maize receives and harvest, have over-run the land. Indeed, in some cases, it is difficult to decide whether the crop is maize or some new type of yellow flowered chicory. The competition for nutrients and for water is generally won by the weeds and the crop suffers badly. It is this successful competition for water on the part of the weed that gives the foundation for the cry of decreasing rainfall; it is not a decrease in the rainfall but a decrease in the available rainfall that is limiting crop production. Unlike the rain, beyond human control, notwithstanding claims to the contrary, the control of the availability of the rainfall is largely within the powers of the farmer. The control entails rotation of crops, maintenance of soil structure, and clean cultivation and tillage at the proper time.

Single crop farming, unlike planting, does not demand very close supervision, and where coffee plantations are measured in tens of acres, maize farms are measured in hundreds. These large farms unless heavily capitalised and run on factory lines, cannot be kept cleanly cultivated and, as long as they are retained, their owners will have to be content with a decreasing return due to increasing competition for water and nutrients by weeds.

The decrease in nett return on the larger farms is becoming so serious that a plunge into rotational farming, even of the simplest type, cannot be undertaken lightly, lest the loss on the area under unproductive crops absorb the profits on the rest of the farm. The necessary manuring entailed means so heavy an outlay on fertilisers that the large owner cannot risk the expenditure; an application of as little as 100lbs. per acre of Seychelles guano, the cheapest phosphatic manure available in Kenya, involves the man with 1,000 acres under maize in an outlay of £300 to £400. Unless he have a large capital, so as to stand any losses, it will be impossible for the farmer on a large scale to utilise the rainfall, the limiting factor to maize production, to its greatest extent. The day of the smaller farm cultivated more intensely, probably yielding a greater nett return than the large farm, is dawning. Until this condition is attained the necessary freedom from weeds will not be secured.

Much may be done while the present system lasts by cleaning the field as soon after harvest as possible instead of waiting till the time of ploughing. The burning of the stalks early would destroy a great many weeds. An early ploughing to enable the weed seeds to germinate readily followed by cultivations to destroy the young weeds will rapidly decrease their number.

At the same time the soil will not be dried out so badly during the dry season; there will be a small residum of moisture in the soil to be added to the rains. Into the rotation must be introduced crops capable of smothering the weeds. The system outlined can only be fully applied on a small farm.

Before any rotational system of farming will be adopted it must be shown, by costed demonstrations, that the system will give an increased nett revenue over the period of the rotation, and that the unproductive leguminous green manure crop only means a temporary loss of revenue for that field only. Proof only will cause the farmer to depart from his present practices.

This insistence upon the use of leguminous green manures, when the wealth of the indigenous flora in legumes and the time the soil has been under cultivation are taken into consideration, may appear

to be premature. Field observations which have been substantiated in some cases by trials, have indicated that there is a wide spread condition of nitrogen deficiency. Whether there is an absolute deficiency of nitrogen or a deficiency of available nitrogen only it is at present impossible to say definitely; laboratory investigation into the matter has not yet been possible; the latter explanation seems to be the more probable; it seems unlikely that most of the great accumulation of nitrogen in the virgin soils could have been removed in the time during which the soils have been under cultivation. It is probable that there is some factor interfering with the processes of nitrification. At the same time it has been found that the residues of leguminous crops increase the yield of cereals. For the time being the nitrogen requirements of the main crops can most economically be met by the use of leguminous green manures. If laboratory investigation elucidates this problem it will be possible for the accumulated store of nitrogen to be drawn upon.

In connection with the cultivation of legumes some most unusual observations have been made. It has been mentioned above that ordinary sweet clover is a failure as a green manure crop. Sweet clover seed was inoculated with a watery suspension obtained from lucerne nodules. It has been shown elsewhere that cultures of the bacillus obtained from lucerne would strongly infect sweet clover and vice versa. The plants from the inoculated seed, here, were quite free from nodules and were only dwarf plants. Recently it has been observed that volunteer plants of sweet clover on the plots previously sown to sweet clover were carrying a few small nodules. It appears that the microbe is adjusting itself to the new host plant. Similar observations have been made in connection with other plants. These observations open up a new line of work upon the characteristics of the nodule organism. Is the variety, that is beginning to infect the sweet clover, the same as that infecting lucerne, or is it a variety, normally infecting some of the native legumes, adjusting itself to a new host plant supplying conditions not far removed from its original host? Or is there, on the other hand, some soil condition that, until the plant has adjusted itself, bestows increased immunity to infection by the requisite strain of *Pseudomonas radicicola?*

As soil work progresses in Kenya innumerable problems of this type, problems of high scientific interest having a direct bearing upon farming practice, will arise. Many of these are of fundamental importance and will have a bearing not only upon the type of soil but upon all the soils of that class.

In addition to problems directly affecting the farmer or the farming practices there are awaiting study many soil problems, the connection of which to farming practice may not be evident but which will throw light upon a large number of partially understood phenomena. Into this category falls the relationship between the soil and the vegetation. This can only be studied properly while the true virgin vegetation still exists; changes due to cultivation would provide a corollary study. Of the various type soils only those derived from the Laikipian lavas carry true forest; the others carry grass or mixed bush and grass. The deciding factor for forest growth is not rainfall, since strips of soil derived from other formations, invading forest covered Laikipian soil, do not carry forest growth. There is some condition in the Laikipian soils that is favourable to forest growth. It is not always present in the Laikipian soils as is shown

by the presence of large treeless glades in heavy forest. The most interesting of these treeless zones is on Mount Kenya on soil which exhibits all the type characteristics of forest soil. This treeless area extends, as far as could be ascertained in a hurried visit, up to the snowline.

In the grass and bush and grass lands most interesting variations in vegetation exist. The grass changes from one group to another group quite different in character; some of the changes being so sharp as to appear artificial. The species of tree change suddenly, in one case where the variations are especially interesting, from one of the *Proteacæ* to species of acacia. Here a soil change is also evident.

There can be no doubt but that the vegetation is an indication of soil conditions, but what these conditions may be is at present a matter of mere conjecture. A great deal of work will have to be done, work which should be undertaken before these vegetal associations are lost to study.

The results of this work will be of great value to agriculture and to science in general, but until there is in Kenya a staff large enough to undertake the investigation of such fundamental problems, while those of immediate application are still awaiting attack, this work will have to wait. Perhaps the broader aspects of this work as it appears to East Africa in general would be undertaken by the Amani Institute.

Mr. SIMPSON thought that it was appropriate that they should open the proceedings with a discussion on soil problems. Mr. Beckley had given them something to think about. The value of a paper, such as the one just read, was very great because it made them realise what their problems were, but it was very difficult to get up and criticise it at once. In countries where the cost of manures must naturally be very great they could not give too much attention to the consideration of their soil problems. Some manure was introduced into Uganda which cost them more in transport from Mombasa than the actual cost of the manure, so that it was very necessary for them to think out some method of keeping their soil in good condition by methods of cultivation, rotation of crops, and the growth of cover crops. It was interesting to hear that phosphates were deficient, and anything they could possibly do to keep up the amount of soil humus was very important. The question of humus brought them to the question of cover crops. In Uganda, they had plantations which had been under cultivation for some years, and there were cases where all the top soil had gone. It was going to be very difficult and a costly matter to get these soils into anything like crop carrying capacity. In conclusion, he would say that if the papers which were to be read were anything like the high standard of the paper just read they would be given much food for thought.

Mr. KIRBY was interested that buckwheat should be suggested as an intercrop in coffee. Among natives in Tanganyika Territory Eleusine, a plant of roughly similar habit, was grown sometimes with coffee with very damaging effect. Some explanation of this difference would be valuable.

Mr. BECKLEY said that the effect might depend upon a difference in root habit. On one of the coffee plantations they would be visiting in a few days, buckwheat had been used for years past and had been most successful. It was one of the most interesting demonstrations of this plant.

Mr. WORTLEY observed that buckwheat had the advantage of regenerating itself under certain conditions.

Mr. TRENCH said that they had found that buckwheat had choked *Macdonaldi;* it kept down weeds and cleared the shamba in two years.

Mr. KIRKHAM asked if any study had been made of the rate of loss of nitrogen from soil. He experimented with the red soil at Ngong and Kyambu, and found that in a period of nine or ten years the humus and nitrogenous matter had been reduced by 50%; this worked out at a loss of humus equivalent to ten tons of farmyard manure per acre per annum on soil with no cover crop. Maize crop soil would have more cover than coffee shambas. He thought that this was an important matter, emphasising the necessity of soil cover in connection with the subject of manuring. He was especially interested in this question in connection with the soils of Zanzibar, where they had some light soils which undoubtedly wanted some introduction of humus. If the green manures which Mr. Beckley had been speaking about were suitable for an altitude of 4,000 ft., he would be glad to receive suggestions for the coast districts.

Mr. BECKLEY said that experiments had been for the higher altitude; but velvet bean and pigeon pea might be most suitable.

Mr. KIRBY stated that the bonavist or lablab bean did very well at sea level in Tanganyika.

Mr. TRENCH said that an interesting experiment had been made during the year with bituminous paper mulch; this had been used for a crop of coffee and in nine months it was at least 6 inches taller than the adjoining trees, which had no mulch at all. The mulch also served to keep the soil damp in dry weather.

Mr. KIRKHAM observed that Mr. Beckley had told them that the soil was very deficient in phosphates. With regard to this question, he had been making enquiries concerning Seychelles guano, but it was very difficult to obtain information. Seychelles guano was supposed to contain approximately 60% calcium phosphates; the cost delivered at Zanzibar for 400 ton lots was £3 10s. per ton.

THE CHAIRMAN (Mr. Holm) said that the position with regard to the transport of Seychelles guano was that the British India Line was not permitted to carry on its passenger steamers more than 25 tons of guano at a time; this was insufficient, except for individual needs. The Company had informed him that if there were sufficient trade with the East African territories they could organise the sailing of steamers to carry about 400 tons. In Kenya, at the present time, they had about reached the position when orders could be placed for these small ship loads, and he thought that Zanzibar's present requirements might be met by the 25 ton lots transported by passenger steamer.

He would like to support the views expressed by Mr. Simpson as to the value which Mr. Beckley's paper might have on conditions of agriculture in East Africa in the future. He did not think that there was any doubt in the minds of those who had looked into the subject that, despite the fact that the soils of those territories as a whole possessed high productive capacity, there were to be found soil problems which it was the duty of Departments of Agriculture to investigate. The great difficulty in his experience had always been

that they were not placed in a position to work in advance of the needs of the country, and it took many years for problems of the kind indicated by Mr. Beckley to be investigated and dealt with in a suitable manner. The question of the conservation of what might be termed " soil capital " was, he thought, of the utmost importance in the case both of European settlement and the native population. Experience in other countries of the world had shown that the European farmer, in the early stages of his farming, lived to a large extent on his soil capital. In the case of the native agriculturists, it was expedient that they should be assisted in preserving the fertility of their soils. Having regard to the primary object which the soil served the native in the supply of his food requirements, it was the duty as well as the responsibility of Departments of Agriculture to see that the productive capacity of the soil in the native reserves was preserved as far as possible. One noticed in South Africa the importance of the question of humus of soils exposed to the sunlight of sunny regions; it was also apparent in East Africa, and he had been very interested to see, since Mr. Beckley had been in Kenya, the views he expressed in respect of soil treatment for preserving the physical structure of the soil. He would like to compliment Mr. Beckley on his paper, and to point to its value particularly as an indication of future lines of investigation.

Mr. BURTON asked whether it would not be possible for the Conference to decide exactly what the farmer should be told to do in this matter.

After some discussion, it was the opinion of the Conference that this was rather a matter for the individual Agricultural Departments to deal with.

THE CHAIRMAN (Mr. Holm) thought that the points raised by Mr. Burton were important, and that they should be covered and dealt with by the Agricultural Departments when their officers had been able to secure the necessary accurate information on which to base their advice. He thought that it was necessary to bear in mind that they were still on the threshold of these investigations and were, to a very large extent, ignorant of the conditions in the country, so that they were not in a position to state precisely what course should be adopted.

Mr. KIRBY raised the question of deposits of fertilisers in East Africa; and, after considerable discussion, the following conclusion was adopted:—

> THAT the attention of the Governments of East Africa be drawn to the possibility of the existence of deposits useful as fertilisers in the various territories, and that such Governments be asked to consider the recommendation that their respective Geological Departments should make this matter a prominent subject in their normal investigation and report.

CHAPTER III.—INDUSTRIAL ALCOHOL.

THE ECONOMICS OF INDUSTRIAL ALCOHOL MANUFACTURE FROM AGRICULTURAL PRODUCTS.

Mr. FOX read the following paper (referred to in the agenda as T.C.(C)Ag.7):—

The requirements of motor transport during recent years have increased the demand for liquid fuels to such an extent that consumption is tending to exceed production. Practically all the fuel used is obtained from crude petroleum and whilst there is no shortage at present, considerable doubt exists as to the sufficiency of future supplies, for it appears to be the general opinion that reserve supplies will be exhausted within a short period. The seriousness of this prospect has led to considerable investigation into the possibilities of producing alternative fuels and of these fermentation alcohol is commanding much attention.

There are great possibilities in the use of agricultural alcohol for power purposes, but the danger exists that it may receive its death blow in competition with fuels produced by the liquefaction of coal or alcohol synthesised from water and carbonaceous matter. Bearing in mind the probability of serious competition by these other liquid fuels, alcohol will be considered as a possible rival to the fuel now holding the market, namely petrol.

1. Extent of Supplies: Since alcohol is produced from plants directly by the fermentation of sugar, and indirectly by the conversion of starch and cellulose, the resources, unlike those of petroleum, are practically inexhaustible, and production might be expanded almost indefinitely.

2. Yields: The yields of alcohol from raw material and motor spirit from crude petroleum compare favourably with each other.

3. Costs of Production: Here petroleum has the advantage, for although the cost of refining crude petroleum is about the same as that of manufacturing alcohol, a large and readily available supply of petroleum is obtained for the cost of merely sinking the well, whereas alcohol has to bear the recurrent costs of growing, harvesting, and handling large quantities of raw material. Further, in the petroleum industry, productive costs are reduced to a mimimum by utilising the bye-products, all of which are marketable, and if the manufacturing costs of alcohol are to be kept low, it will be essential to utilise the distillation residues which possess a certain manurial and feeding value. These residues contain the whole of the fertilisating ingredients taken by the plant from the soil, and by returning them to the soil, either directly, or by feeding to stock, the alcohol will be obtained at the expense of the elements of air and water.

It has been difficult at short notice to obtain data to enable a comparison to be made between the actual costs of producing petrol and alcohol, but the little information which it has been possible to collect should prove sufficient for arriving at some approximation.

Cost of Producing Petrol: Numerous estimates have stated the average cost of producing a gallon of petrol and delivering to steamer for export to be 6d.—7d. and the Standing Committee on the Investigation of Prices (1920-1921) estimated the maximum cost to be 10d.

Petrol is landed in England to-day at a price which enables it to be retailed at 1s. 6d. per bulk gallon, and there appears to be no reason why it should not be delivered to Mombasa at the same price. With serious competition it could be marketed at a little less than this, and if power spirit is to compete with petrol in East Africa, the production costs must be low enough to combat a fall in the Mombasa price of petrol, exclusive of import duty or taxes, to about 1s. 6d. per gallon.

For export, power spirit would have to be delivered to seaboard for something less than 1/- per gallon, which appears not to be possible on account of rail freight.

Cost of Producing Alcohol: The cost of manufacturing alcohol from cane molasses has been estimated at 4d. to 5d. per gallon, including interest on capital and depreciation of plant. Heriot at a meeting of the Society of Chemical Industry, 1915, quoted actual figures from the balance sheet of a Demerara Distillery showing the cost of producing 90% alcohol to be as low as 3d. per gallon, but he estimated the cost of 95% alcohol to be 5d. per gallon.

In 1920, alcohol was produced in Cuba from cane sugar residues for 6½d. per gallon and retailed at 10d., and during the same year in Brazil the retail price was 9d. per gallon.

Fuel accounts for 30—50% of the manufacturing costs and according to the *South African Sugar Journal*, 1920, the coal consumed in making one gallon of alcohol was stated to be 7—8 lbs. Coal is imported into Mombasa in large quantities for about Shs. 32/- per ton and is conveyed to any station on the main line in 20 ton lots at a flat rate of Shs. 20/- per ton.

Therefore the probable cost of coal at any station, including freight and handling charges, is about Shs. 56/- per ton. Assuming it to be as high as Shs. 65/- the coal required for producing 1 gallon of alcohol would cost not more than 3d. Wood should be cheaper still and by doubling the fuel cost, 5d.—6d. is obtained as the average cost of producing a gallon of alcohol.

On the other hand the Crown Agents for the Colonies give the fuel consumption as 15 lbs. of coal and although this probably refers to the manufacture from starchy material, in which extra power is required for the preliminary conversion of the starch to fermentable sugars, the difference between a consumption of 7 and 15 lbs. of coal is difficult to explain. With a coal consumption as high as this the cost of manufacturing a gallon of alcohol would be just over 10d.

Desborough, also, at a meeting of the Society of Chemical Industry, 1920, estimated the cost of manufacturing 95% alcohol from starchy material to be 9d. per gallon. This included depreciation of plant, but did not include the interest on capital which he calculated at 4d. per gallon, thus bringing the cost, apart from that of the raw material to 1s. 1d. per gallon. For the interest on capital to be 50 per cent. of all other charges appears extraordinarily high, and it is probable that these figures are above normal, and were based on post-war industrial conditions in England.

To etherise alcohol for the production of a motor spirit probably costs 2d. or 3d. per gallon, and assuming the average cost of producing one gallon of alcohol to be 6d. power spirit could be placed on the local market only if the raw material for making one gallon were purchased for not more than 5d.

Industry is run on a narrow margin; it is attention to detail that makes the difference between success and failure, and unless the manufacture of alcohol is conducted on sound lines, with modern plant and efficient chemical control, it cannot hope to compete with petrol.

By using the Boulard process in which a special mould performs the saccharification of the starch and the fermentation of the sugars, it is claimed that the period of fermentation is reduced considerably, the yields of alcohol are increased, the fuel economised, and consequently the manufacturing costs lowered. In the case of molasses, for example, it is possible to work with a much stronger wash of gravity 1090—1100 degrees instead of the usual 1070—1080, and the cost of distilling the stronger alcoholic solution obtained by this process is obviously less.

The strictest economy is necessary in the fuel consumption which is responsible for nearly half of the manufacturing costs with the methods now in use.

It appears that a considerable saving in fuel will be effected if a recent improvement in the process of manufacture is adopted commercially. This consists of distilling under a partial vacuum with three or four multiple effect stills under successively lower pressures. With the usual distilling plant a consumption of 35 lbs. of steam per gallon is considered good practice, but by distilling under partial vacuum it can be cut down to one-third or one-quarter. A further advantage of working under a partial vacuum is that below 70 m.m. of mercury there is no mixture of constant boiling point.

However, the controlling factor in the cost of production will be the price of a unit of fermentable material delivered at the factory, and this will depend on:—

(a) the percentage of fermentable matter;
(b) the yield per acre;
(c) the cultivation and handling costs.

The third factor is all important, and although a crop gives the smallest yield of alcohol per acre, it may still be the cheapest source of alcohol.

Raw Material: This falls roughly into three groups:

(1) Starchy material such as Cereals, Potatoes, Cassava, etc.
(2) Sugar containing plants and residues, e.g., Sugar Cane, Molasses, etc.
(3) Cellulosic material, such as wood, straw, etc.

Starchy Material: Amongst the many starchy products of Kenya which have been stated to be suitable for conversion into alcohol are Maize, Cassava, Sweet Potatoes, and Yams.

The cereals are too valuable as foodstuffs to offer possibilities as a source of alcohol, and it is only the surplus from an over-production which could be put to this use. Even then the distiller would be faced with the uncertainty of supplies for in seasons of poor crops he would find his raw material absorbed for use as food.

The production of wheat in Kenya, for example, is insufficient to meet local demands, but even supposing a surplus were available for conversion into alcohol its manufacture would be economically impossible. Wheat contains 65% of fermentable carbohydrates, a

ton yielding about 83 gallons of alcohol and at the present price of say Shs. 20/- per bag the material alone necessary for making one gallon of alcohol would cost 2s. 8d.

Maize: Maize contains 65—68% of fermentable material and a ton yields about 83 gallons of 95% alcohol, equivalent to 60 gallons per acre with an average crop of 8 bags per acre. Assuming the cost of maize delivered at the factory to be 8/- per bag, the material for making one gallon of alcohol will cost 1/1. Maize alcohol might compete with the present price of petrol, but it could not do so if prices fell to 1/6 per gallon, unless the maize could be purchased for 3/- per bag. The residues from each ton of maize used contain 51 lbs. of oil, which could be recovered cheaply by expression, leaving 224 lbs. of cake. The profit realised by selling the oil for edible purposes, or soap manufacture, and the cake as a fertiliser, should enable the manufacturing costs of the alcohol to be reduced by about one penny per gallon.

Sweet Potatoes and Yams: Sweet potatoes contain 25% of fermentable carbohydrates and yield, in practice, 33 gallons of alcohol per ton. At 5d. per load, or 14/- per ton, the potatoes for making one gallon would cost 5d. and alcohol production would be possible.

The probable acre yield in Kenya is only three tons, equivalent to 100 gallons of alcohol, and with a gross return of Shs. 42/- per acre it would not pay to grow the crop. Further, sweet potatoes require a rich soil which could be put to better use in growing a more valuable crop such as maize or coffee.

Yams: The acre yield of alcohol is similar to that of potatoes, and for the reasons stated the commercial production of alcohol is not possible.

Cassava: The fresh roots contain 25% of fermentable matter, a commercial yield of 37 gallons of alcohol per ton being obtained.

The factor controlling the price at which Cassava can be delivered at the factory will be the harvesting expenses, which are high, as the roots have to be dug up by hand; but allowing a fair margin, it should be possible to produce Cassava for 15/6 per ton, *i.e.*, 5d. per gallon of alcohol. This is based on the assumption of a nine ton acre yield which is stated to be the average in several countries. Yields of 6.8 and 9.0 tons were obtained from plots at the Scott Agricultural Laboratories this year, and the yields at the lower altitudes should be not less than this.

Cassava, which thrives on light soils, is drought resisting, and it is not improbable that it could be grown successfully on large areas below Sultan Hamud, which at present are wholly unproductive. The possibility of growing Cassava profitably in this area is put forward merely as a suggestion, and experiment on a small scale would prove definitely and at little expense, whether the crop can be grown under the climatic conditions obtaining there.

Assuming a crop is obtained annually, and the yield is only seven tons, 1,500 acres would provide sufficient material for a unit distillation plant, but allowing for the preparation of the land between crops twice this acreage would be required.

Materials containing Sugar:

Sugar Cane: Seventeen gallons of alcohol are obtained from a ton of cane and assuming a crop yield of 35 tons, each acre produces 595 gallons. The cost of growing cane in Kenya, including delivery

a reasonable distance to the mill, is about 6/- per ton, or in terms of one gallon of alcohol, 4½d. At this price alcohol could be manufactured cheaply, but there is such a great demand for sugar that it is a much more profitable substance to produce.

Two and a half tons of sugar are obtained from each acre of cane, and the cost of manufacturing it on a large scale in a modern mill is from £11 to £12, even when the labour employed is wholly white, as in Australia.

The local wholesale price of sugar is £35 a ton, and the manufacturers could hardly be expected to undertake the production of alcohol instead of sugar, for it would not pay them unless the alcohol was retailed to yield a profit of 2/- per gallon.

Cane Mollasses: Cane Molasses, which as a by-product of sugar manufacture costs practically nothing, offers the greatest possibilities as a source of alcohol.

Canada manufactures industrial alcohol from molasses which she imports from the West Indies, and if the industry is able to bear transport of the raw material to this extent there is no reason why alcohol production should not be possible in Kenya where molasses is produced.

Alcohol can be produced cheaply from molasses and the establishment of a distilling industry in Kenya will depend upon the molasses output.

The smallest distilling unit which it is stated can be run profitably has an output of 900—1,000 gallons of alcohol per day of 24 hours.

The composition of final molasses varies, but 56% may be taken as the average sugar content expressed as invert sugar, and on a commercial scale a yield of 73 gallons of alcohol per ton is obtained. Therefore in order to feed the smallest distilling unit 13—14 tons or about 2,000 gallons of molasses will be required daily.

The Victoria Nyanza Sugar Company is the only mill in Kenya at present operating on a scale large enough to undertake the manufacture of alcohol. Its crushing capacity is about 375 tons per day and when working at full pressure the daily output of molasses is about eleven tons or 1,800 gallons. Thus during the crushing season Miwani could produce 700 to 800 gallons of alcohol daily, and although this is less than that required for the most economical working, there is no reason why the manufacture of alcohol should not be undertaken. Rather than run this large quantity of molasses to waste, it would be sound policy to supplement it with other fermentable material in order to increase the daily output of alcohol to 1,000 gallons.

Cassava appears to be a most suitable supplementary material, for not only does it give a high yield of alcohol per acre but the roots can be stored and used for supplying the distillery in the off-season when crushing has ceased. Also it could with advantage be introduced into a rotation with cane. During the crushing season one to two acres of Cassava per day should be sufficient to supplement the molasses output and in the off-season when the mill has closed down the distillery could be kept running on 4—8 acres of Cassava per day according to yield. At Miwani the crop should grow well on the lighter soil towards the foot of the Escarpment.

Uganda is setting an example to Kenya, for a distillery which has been erected to work in connection with the sugar mill at Jinja, is about to commence operations. The milling capacity is 400 tons of cane per day, and the distillery is capable of producing forty gallons of etherized alcohol per hour.

Another sugar mill with an annual output of 10,000 tons of sugar is to be erected at Kamiti, and when it is crushing to its full capacity it will produce molasses sufficient to run a unit distilling plant.

The consumption of petrol in Kenya and Uganda in 1925 was 1,500,000 gallons and it should be possible for these three mills to supply Kenya and Uganda with motor spirit to the extent of one half of this amount.

According to different authorities the cost of producing 95% alcohol, without recovering potash and nitrogen from the residues, and excluding the cost of molasses which is rightly charged to the sugar, has been stated to be approximately 5d.

It will pay to concentrate the spent wash to a fertiliser syrup which can be easily transported and applied to the soil. This can be done economically in a multiple effect, the vapours from the last unit being finally used to heat the column.

Heriot (meeting of the Society of Chemical industry, 1920) quoted actual working figures shewing that the value of the fertiliser syrup produced in this way, covered the total working expenses of a particular distillery leaving the alcohol as a by-product free of cost.

At the present local prices of artificial fertilisers the fertilising ingredients in the spent wash from each gallon of alcohol would be worth about 6d. Allowing for the cost of recovery, a portion of this sum could be placed to the credit of the alcohol thereby reducing working expenses.

Sisal Waste: Mr. A. C. Barnes, Chemical Officer, examined the undiluted juice after decortication and found it to contain 1.65% of fermentable matter. It was concluded that from liquids with such a low percentage of fermentable matter, alcohol could not be produced by any economical process.

Very dilute liquors containing 1.3% to 2.0% of fermentable sugars are obtained in the manufacture of wood pulp by the sulphite cooking process, and after fermentation produce a wash containing about 1.0% of alcohol, which is recovered by distillation.

The cost of recovering alcohol from sisal juice should be about the same as that of sulphite liquor and estimates of the latter vary from 5¼d. to 7½d. per gallon pre-war to more than 1/- during the war.

If alcohol can be recovered economically from sulphite liquor, then its recovery from sisal juice is not impossible, and the matter might be worth further investigation.

Cellulosic Materials:

Wood Waste: The cellulose of plants may be converted into fermentable sugars by hydrolysis with mineral acids under pressure and at elevated temperatures. The processes employing the use of dilute acids are cheaper, but the highest yields are obtained from those in which strong acids renders their use costly and the commer-

cial production of alcohol from cellulose will depend upon processes which combine the cheapness of the dilute acid process with the high and almost theoretical yields obtained when strong acids are used.

Numerous attempts have been made, notably in North America, to convert the waste of the lumber industry, sawdust, tops, etc., into alcohol, and while the possibilities have been demonstrated under laboratory conditions, the success of the industry on a commercial scale has not been definitely proved. A ton of dry wood yields, under laboratory conditions, 15 to 21% of sugar or 33 gallons of alcohol, but in practice the yield is only about one half of this.

The U.S.A. Forests Products Laboratory, Madison, Wisconsin, stated (1921) the yield of alcohol from a plant handling 180 tons of wood waste daily to be 3,600 gallons at a cost of 25 cents a gallon. Their experiments showed that the yields varied according to the type of wood from 6.8 to 25.8 gallons per ton.

The cost of manufacture with other plants operating in the States has been stated to vary from 6.4d. to 1/- per gallon.

If the economical production of alcohol from waste wood by existing processes has not been definitely proved in Canada and the United States, then it is hardly possible in Kenya where the tonnage per acre is very much less.

Straw, etc.: Attempts have also been made to obtain from straw, stalks, etc., by acid hydrolysis, yields of alcohol as high as from wood, and although processes have been patented no information is available of any operations on a commercial scale.

The ratio of straw to grain in the case of maize and wheat, for example, is 1 to 1 and 1.7 to 1 respectively, and if the straw could be converted into alcohol the cost per gallon of the raw material from these crops would be reduced by one half. The production of maize spirit might then become possible.

Probable production of Competitive Fuels.

The problem of the synthetic production of alcohol and liquid hydrocarbons is occupying the attention of Chemists and Engineers, and it would not be out of place to consider briefly certain of these synthetic products. In the majority of the processes carbonaceous matter is converted into liquid hydrocarbons with the aid of hydrogen gas, and it is possible that before long catalytic hydrogenation will have solved the liquid fuel problem.

Coal is the carbonaceous matter at present used for the production of these fuels and as the world's reserves are estimated by authorities to be 3,000 years cheap production would prove a menace to the use of agricultural alcohol for power purposes.

Berginisation of Coal—Motalin.

The conversion of coal into liquid and gaseous hydrocarbons is the outcome of developments in the original process of Dr. Bergius. A conversion of as much as 85% of the coal by weight equivalent to a minimum of 140 gallons of liquid fuel per ton can be obtained by hydrogenation at increased temperature and pressure, and the liquid obtained is marketed as a motor spirit under the name of "Motalin."

METHYL ALCOHOL—METHANOL.

Two processes, the Patart and the Badische Anilin und Soda Fabrik, are operating in Europe for the synthesis of methyl alcohol which is known commercially as methanol.

The synthesis is effected by passing mixtures of producer gas (carbon monoxide) and hydrogen at a pressure of 200 atmospheres and a temperature of 400—500 deg.C. over a catalyst of zinc oxide and chromic acid. On cooling the reaction product under pressure, a good yield of practically pure methyl alcohol is obtained. The process is stated to be economical and during last year methyl alcohol has been exported from Germany at a price which threatens the wood distillation industry.

SYNTHOL.

Carbon monoxide is also hydrogenated in the presence of iron and potash at a temperature of 410deg.C. and a pressure of 100 atmospheres to a complicated mixture of organic derivatives which is sold as a motor fuel under the name of " Synthol."

It is significant that the German Dye Trust is erecting large plant for the carbonisation of coal in the centre of the German coal area with the object of producing either motalin or methanol to the extent of 250,000 to 300,000 tons per annum.

Germany's annual consumption of motor fuel is 600,000 tons, and it is the intention to increase production to this amount.

The Trust has made provision for the marketing of the fuel by acquiring a half interest in the Deutsche Gasolin Company and it appears that the oil companies fear the competition of the new fuel in the German fuel market, for both the Standard Oil Company and the Shell Company have entered into partnership with the Trust, each having acquired 25% of the Deutsche Gasolin shares.

In conclusion it might be mentioned that the Maihle process, in which vegetable oils are cracked, and the products hydrogenated in the presence of a catalyst, is in operation in Belgium on an experimental scale. If the process develops the oil-bearing seeds of the tropics will play a part in supplying future requirements of fuel oil.

Summary.

In view of the increasing demand for liquid fuel and the doubtful adequacy of future supplies of petroleum, the possibilities of producing alcohol as an alternative fuel are discussed.

The suitability of the different raw materials is considered and allowing for a considerable fall in the price of petrol it is concluded that alcohol can be produced commercially in Kenya from molasses and possibly from cassava.

Even though it can compete with petrol attention is drawn to the possibility that agricultural alcohol for power purposes may be driven from the market by synthetic alcohol or by a competitive fuel produced by the liquefaction of coal.

Mr. SIMPSON regretted that, as agriculturists, they could have very little to say. The question of industrial alcohol was a most important one to tropical and sub-tropical countries and had been considered very carefully for some considerable time. In Uganda, the question was one of very grave importance, as motor transport

was the main means of transport and any developments which would tend to bring down the costs were of great interest to them. They would be able to grow the raw material for industrial alcohol very easily in Uganda, and he was of opinion that sugar cane would be hard to beat.

Mr. KIRBY said that there was one material which had not been mentioned, and which might be of value in East Africa, and that was the Nipa palm, which grows in the east. Investigation to find out whether this would grow in Tanganyika in the mangrove swamps was being undertaken. In Nigeria the possibilities of the use of elephant grass were investigated, but the cost of transport of the raw material was found to render the scheme prohibitive.

Mr. WORTLEY said that in Nyasaland, the matter had been under consideration for some time, but nothing definite had yet materialised.

Mr. FOX said that there was the possibility that alcohol could be produced economically from cassava. The other starch producing crops were of greater value as foods. In Kenya, it was possible that Cassava could be produced cheaply enough for alcohol manufacture near Sultan Hamud.

Mr. KIRKHAM said that cassava could be grown there but the yields would probably be too low to make the scheme a success.

THE CHAIRMAN (Mr. Holm) said that it was not clear why molasses should be supplemented by cassava.

Mr. FOX said that although the largest sugar factory operating in Kenya produced sufficient molasses for the economic production of alcohol, the output fell short of that required for the most economical working. Therefore, it would be sound to increase the daily production of alcohol to 900—1,000 gallons by supplementing the molasses with a small quantity of cassava.

The possibility of using other agricultural products as fuels in internal combustion engines was then discussed. The possibility of vegetable oils being more economical in remote areas than alcohol was considered.

CHAPTER IV.—COFFEE.

(For discussions on coffee pests see Part IV., Chapter III.)

(Discussed at Joint Meeting of Agricultural, Entomological and Mycological Sections.)

SOME ASPECTS OF COFFEE PRODUCTION IN KENYA.

Mr. TRENCH read the following paper (referred to in the Agenda as T.C.(C)Ag.4):

In approaching the subject of Coffee growing in this Territory, there are a great number of points to consider. Firstly, the crop is one which demands the closest study, in order that due advantage may be taken of every favourable variation and condition. Secondly, the system under which coffee is produced in Kenya, namely, small plantations dependent on native labour from reserves, gives the crop an element of uncertainty, which every effort should be made to remove, as much from the country and Empire point of view, as well as that of the grower. Thirdly, the problems " What is the best

variety to grow in some areas, the use of shade, its efficiency, the special treatment of the crop, the various methods of training and pruning the plant, marketing," and so forth, all demand a nicety of judgment in dealing with them.

Historically, the coffee industry started in Abyssinia where the species *Coffea arabica* was discovered. "Arabica" is the most important of all the cultivated species, and is admittedly the best. This species is divided into several varieties and strains, and one of these varieties, namely, Mocha, is mainly the nucleus of the industry in Kenya.

Mr. John Patterson of Thika claims to have imported the first coffee seed into the Colony in 1893; the same year the French Fathers obtained their seed from Aden, which was planted at Bura Mission. The seed introduced by the French Fathers was apparently mixed, containing two or more types of *Coffea arabica*, Mocha being predominant, and the smaller percentage resulted in a mixture of bronze tipped trees.

The seed imported by Mr. Patterson was of the bronze tipped type, similar in some respects to the coffee that is grown in Central America. In 1896, seed from the trees propagated at Kibwezi from the original seeds imported by Mr. Patterson were sent to Fort Smith in the Kyambu district; this type was not widely distributed in the Highlands.

In 1900 some coffee plants were taken from Bura Mission to the then newly founded St. Austin's Mission near Nairobi. This laid the foundation of the coffee industry in Kenya, as the majority of coffee plantations here have been established from seed first grown at St. Austin's Mission. To-day the coffee plantations in this country are not uniform as to variety, as one can see on nearly every estate a small percentage of bronze tipped trees mixed with Mocha. This shows the importance of seed importation into a country and that it is one of the chief fundamental principles to observe. In dealing further with this matter, it might be of interest to mention that there occur at least four variations in these bronze tipped trees:

(1) A coarse broad leaf, with a light bronze tip.
(2) A narrow leaf, with a darkish bronze tip.
(3) A tree similar in appearance to Mocha, with bronze tipped leaves.
(4) A freak tree, having all bronze or copper coloured leaves.

The first mentioned is undoubtedly the hardiest, and appears to be more resistant to disease. It produces a small yield, and bears a large percentage of elephant and mal-formed shaped beans. The second produces a good yield, and is susceptible to die-back. The third is outstandingly the best: it produces a good yield and is hardy The fourth is of no commercial value and should be dug out of a plantation.

In 1922, it was decided that owing to the difficulty in seed selection from these mixed types, or strains, to discourage coffee planters from establishing any bronze tipped coffee, which was not propagated from either Blue Mountain or Mysore varieties; both of these varieties have now been established in the Colony, and from observations made they are found to be more suitable than Mocha at the higher altitudes, 6,000 feet and over. Of the two, the Mysore

variety would be selected for preference. Our experience here coincides with the rule carried out in Central America, namely, that the bronze tipped coffee is established in the Highlands owing to its hardiness and resistance to cold and Mocha, or Bourbon as it is called there, is planted in the lowlands. In the early days of pioneering in the Colony, coffee was coffee, regardless of type, and so Mocha by force of circumstances became the predominant variety in so much as over 90% of the coffee plantations are established with this variety. In this connection one is faced with a big question, whether the liquoring qualities of " Kenya " coffee would have been better had a good strain of bronze tipped coffee been established generally throughout the Highlands instead of Mocha. What we do know, is that the liquoring quality of " Kenya " coffee ranks amongst the most popular on the British and Continental markets. It has become very popular as a high-grade mild coffee, and commands a high price. Let it be suggested that " Mysore " and " Blue Mountain," grown in this Colony, will not produce as good liquoring qualities as " Mocha " for purposes of discussion in regard to growing the former two at the higher altitudes. I am inclined to the view that it is better for planters to go in for the hardier trees, although the quality of the crop might not be better with less bearing propensities, than for the more delicate types. I have, however, no reason to suppose that the liquoring qualities of Blue Mountain and Mysore, will not be equally as good.

The Empire consumption of coffee is far greater than Empire production. There are many regions in Africa not yet studied for the purpose of growing this crop, and there might be many regions not much thought of at present, which might be found to have vast possibilities in which the type, variety or species of coffee used, might play an important part. Other coffees under trial in the Colony are known as " Jackson's Hybrid " and " Kent's arabica," which were imported from India. They have not been here long enough for me to give any definite information as to their suitability or behaviour. Another coffee which grows in the Highlands is the indigenous Nandi coffee, which grows wild in the forests. This species is known as *Coffea eugenioides*, which is of botanical interest only. Attempts have been made to cultivate this species without success. When grown under conditions different from its natural *habitat*, it bushes and produces no crop, at its best it is but a poor yielder. This coffee was once boosted by some anti-caffeine cranks, who recommended it as the beverage to drink in preference to plantation coffee, because it is said to contain no caffeine. Coffee has long passed the stage of an occasional luxury to that of a daily necessity. Needless to say the anti-caffeine cranks' campaign has not been successful. Professor Prescott states that " Coffee is very similar to other foods and drinks so far as it agrees with some people and not with others. It would appear that the presence of caffeine is the foundation of its uncertain popularity, but it is of interest to note that the average cup of strong, pure coffee contains about $1\frac{1}{4}$ to $1\frac{1}{2}$ grains. In the ordinary person this quantity is just enough to slightly accelerate the heart beats, to stimulate the circulation, and to clear the brain. Caffeine does not have depressing after-effects."

The next species to be discussed is *coffea robusta*, which is not grown in this colony, but is of interest as it is indigenous in Uganda

and is cultivated extensively there and in Tanganyika. Further, it is next in importance to *coffea arabica*, as reports show that it is more resistant to disease and takes the place of *arabica* when circumstances force this latter to be abandoned.

The introduction of *Robusta* into Kenya has been strictly prohibited in view of the fact that there is the danger of introducing with it the coffee bean borer, *Stephanoderes*. Apart from this, the quality is very inferior to *Arabica* and so long as the Mocha coffee grown here continues to give satisfactory results, there is no object in introducing an inferior species. It cannot be too strongly emphasised that the importation of coffee seed may bring very serious results through the introduction of some disease or pest not at present found in Kenya.

If, however, anyone at any time wishes to conduct experiments with other species or varieties in districts or areas which are unsuited for arabica, arrangements could be made for the introduction of plants instead of seed.

Before passing on to some of our difficult problems, it is necessary that I describe very briefly to you the routine of coffee from the plantation to the market. Coffee seeds are sown in a germinating bed and transplanted into nursery beds four to six inches apart, after they have changed from the violet leaf stage. They are usually planted out in the field at from 12 to 18 months old. The Fly crop, or first crop of cherry, is harvested about the third year, and when the trees are five to six years old they should be producing a fair average crop at anything up to a third of a ton per acre clean coffee. The berry, or cherry as it is termed, should not be picked until it is bright red; on the other hand, over-ripeness must be avoided as fermentation sets in and if allowed to go on too long it will cause a discolouration of the bean which will affect the liquor. The method of harvesting the crop in Kenya is extremely crude, but slight improvements have been noticed since labour shortage has become acute.

This work involves considerable labour, and one of the best methods adopted in harvesting the crop is to provide each picker with a basket having a circumference of from 4ft. 6ins. to 5ft. and a depth of 6ins. The basket is tied around the waist, or slung from the neck. This enables the pickers to use both hands. It will be found that this method of harvesting coffee will be more effective if the coffee trees are trained on the multiple stem system. At the end of each day's picking, the cherries are carted to the factory and pulped; the pulp having been taken off the coffee is subsequently known as "parchment." The parchment is conducted through a channel into a fermenting vat or tank, where the water is drained off and the parchment left to ferment. The time allowed for the process of fermentation varies considerably in this country; it may take from fourteen to forty-eight hours, depending on the climatic conditions. The object of fermentation is to allow the easy and complete removal of the glutinous saccharine matter that is found adhering to the parchment on its first being pulped. The next process is to wash the coffee in a separate tank or a washing channel; the latter is found to be the more satisfactory, not only is the washing more thoroughly carried out, but the parchment is graded by gravity, the lights and inferior coffee being separated from the best grades. The washed coffee is then dried by the sun or by a mechanical process. When the coffee

has reached a certain stage of dryness, that is, when it will break without bending between the teeth it is ready for hulling. It is then graded, hand-picked if necessary, and bagged. Each bag is branded with the estate mark, the weight is stencilled on each bag, and it is shipped to England, where it is sold by auction on the London market.

I will now tackle some of the more important sections in that chain of manipulations already mentioned.

Kenya, as a coffee growing country, is one in which conditions vary almost every ten miles. The special value of rain to coffee is a point to be kept in mind in order that the value may be maintained or enhanced.

Studies carried out for a number of years, and under varied conditions, have revealed possibilities that certain methods of training the coffee plant are more advantageous that the old-established method on the single stem system.

In dealing with this subject, let it be understood, that the single stem tree will be referred to as the " Umbrella " system, and the Agobiada and Capping systems to establish multiple heads, will be referred to as the " Bush " method.

On individual estates in Kenya, where the acreage of coffee is about 100 acres, with a good labour force, and where the owner or manager has a good knowledge of the principles of pruning on the " Umbrella " system, very excellent yields have been maintained. Some of these plantations, over a period of years, have yielded half a ton and more per acre of clean coffee. The average estates, however, have not achieved the same success.

The " Umbrella " tree will produce heavily for a few years, but when the time arrives for careful and proper pruning, which is not generally carried out, the production is practically negligible. Speaking generally, apart from unfavourable weather conditions, the failure to achieve similar success is mainly due to labour shortage and inexperienced workers.

In order to meet these deficiencies, an alteration in the method of treatment of the bushes is advocated.

The " Bush " method was introduced by me as far back as 1916, but it was not seriously taken up until 1921.

There are two methods of training the coffee plant to establish the " bush " system:

(1) To Agobiada, that is to bend and peg the plant at an angle of 70deg. to 75deg., and allow three to four vertical shoots to grow from the base.

(2) To Cap the plant at about 12 to 16 inches from the ground level by cutting the internode adjoining matured wood, and the two primaries on opposite sides of the node are cut off to induce even growth of the pair of suckers, which are to form the future base of the tree. These shoots are capped about 24 inches from the first cap, which will result in four vertical shoots. The operation must be carried out on matured wood.

It has been observed that the Agobiada method can be adopted satisfactorily in nearly all the coffee districts in the Colony, but in humid areas, where growth is very rapid, the capping system would

appear to be more satisfactory, as the growth of the plant is temporarily checked at each stage of capping, thus enabling the plant to develop strength, and to produce a certain amount of secondary growth.

The advantages to be derived in adopting the " Bush " method are :—

(1) It requires considerably less labour in pruning, thereby reducing the cost of pruning to a minimum.
(2) It does not require skilled labour to do the pruning.
(3) All formation of old wood is avoided.
(4) The crop which is produced on new wood is of better quality than that which is produced on old and whippy wood.
(5) Natives prefer to harvest the crop off trees grown on this system, as the trees are more open, thus giving an easier access to pick the berries. Speaking generally, the prevailing method of pruning coffee in Kenya is conducive to neither large production nor labour saving. Although in particular cases this may not apply, yet on the whole the position is as stated.

The conversion of single stem coffee trees is now being carried out very extensively in the Colony. The most satisfactory results obtained from all the experiments undertaken in this connection is by stumping the coffee trees about a month before the rains and allowing three or four vertical shoots to grow. Usually the first crop is borne 18 months after stumping. The big six in coffee production are: Air, light, sun, rain, soil and climate; the trees must therefore be trained and pruned to enable them to benefit from the first three mentioned.

Shade: The next topic I will touch upon is shade. This has been a much discussed subject in the Colony and still remains one of our problems which has not yet been settled.

At the present time a number of coffee planters are considering that they would rather do without shade; in such cases this is due to their coffee being overshaded.

Shade needs careful regulation from time to time to prevent it getting too dense. If it becomes too heavy, the coffee crops are materially reduced. If too thin, not sufficient protection is given the coffee trees.

Speaking generally, apart from the trouble in finding suitable shade trees for various districts, insufficient attention to shade pruning and regulation, etc., and in very many cases, adopting a policy of " letting the shade rip " has done considerable harm in prejudicing planters against the use of shade.

For permanent shade *Grevillea robusta* has been most commonly used. In many cases, it has been planted too thickly and not thinned out from time to time, with the result that after a few years, the shade has become too dense. Further, during long spells of dry weather, the coffee bushes have suffered from lack of moisture, due to the *Grevillea robusta* taking more than its share. In certain districts, however, where the rainfall is high and the growth of coffee affected by cold, *Grevillea robusta*, spaced 36ins. x 36ins., has given satisfactory results, and is still being used.

In view of the fact that *Grevillea robusta* has not the characteristics of a shade tree with spreading branches, one can realise why this tree has not been successful in areas where a spreading tree would be desirable, and where a small number of shade trees to the acre would be an advantage, owing to lack of rainfall. On the other hand, it will be understood why this tree has given better results at the higher altitudes; in the first place, the rainfall is greater, and in the second place, a much lighter shade is required, not so much as to make a shade in the true sense of the word, as to act as an equalizer in extreme temperatures. In the Kericho District, where the rainfall is very great and strong winds are prevalent, *Grevillea robusta* was found very brittle and therefore unsatisfactory. Black wood *Acacia melanoxylon* was substituted and found satisfactory. It is considered, however, that this tree would be detrimental to the growth of coffee in a district where the rainfall is not as heavy as in Kericho, namely 70 inches.

It has always been recommended that a mixed shade programme should be adopted, owing to the embryonic conditions of the coffee industry in the Colony. This has not been generally carried out, with the result that the subject of shade is still tentative. A number of trees are being tried, but it would be premature to give a definite decision as to which might be regarded as the most suitable, as a tree which may be found suitable in one district may prove unsuitable in another. At altitudes of 5,500 feet and under " Mukuyu " *Ficus Mallatocarpa* is promising good results; as also has another tree, not yet identified. *Albizzia moluccana* would have been suitable had it not been found susceptible to attacks of root disease, and it has a further drawback of being brittle. In certain districts, where it has made extremely good growth, it has died out at from five to six years old, but this cause has not yet been ascertained.

With regard to temporary shade, a certain measure of success has been achieved in the use of fast growing trees, yet on the other hand, there are a number of cases where its use has been detrimental to the growth of coffee. In the first place, temporary shade is only advocated under certain conditions, *i.e.*, where hail is prevalent and where the growth of coffee is affected by cold. Secondly, when used, it is essential that permanent shade trees should be planted to take the place of the temporary shade, which should be thinned out from time to time, and after about three years it should have served its purpose. When it has been detrimental to coffee, the trees have been planted too closely and not thinned regularly, and no permanent trees have been established. Trees which are usually selected for temporary shade are very fast growing and are therefore in their nature, surface feeders. Care, however, should be taken to select such as are not too voracious.

A most successful and interesting experiment was carried out by Mr. S. O. Hemsted of the Trans-Nzoia with " artificial " shade, by erecting posts and strands of plain wire over about 50 acres of coffee. The canopy was formed of maize stalks, grass, branches of *macracarpa*, etc. Ordinarily, the effect of shade diminishes the yield, but in this case, it increased the yield from a few cwts. per acre to about three-quarters of a ton per acre. The conditions under which this coffee was grown were not ideally suitable; the growth was affected by cold and clustered very badly. The effect of the " artificial " shade was to

equalize the extreme temperatures between the day and night; the coffee bushes outgrew the " tight " growth and produced very remunerative crops. The outlay in establishing this form of shade is expensive; it is estimated at approximately £13 to £14 per acre. Apart from this, the upkeep is expensive as it requires a considerable amount of labour to renew the canopy from time to time. In this case, however, it has been most successful, and has more than paid for the cost of erection.

The next subject to be discussed is the use of wind-breaks. *Grevillea robusta* has been found the most satisfactory tree for this purpose. Windbreaks have been very much overdone by coffee planters, who once considered that wherever coffee was planted, wind-breaks or windscreens should be established. It has since been realised that they should only be used if the prevailing wing is so severe as to affect the growth of coffee, and when used they should not provide an absolute barrier to wind. The branches should be so pruned as to allow a certain movement of air to circulate through the field. It has been observed that where windbreaks have been allowed to get too thick or dense, that the outbreak of insect pests, such as *Antestia* and *Thrips*, are most prevalent.

In conclusion, I would say that the question of coffee growing in East Africa is full of problems and it would be an error of judgment to lay down hard and fast rules in regard to the cultivation of the crop, but definite rules may certainly be laid down in regard to the preparation and care which should be exercised when the crop has been harvested; the same applies also to seed selection.

Every attempt should be made to introduce labour saving devices, both in the field and factory. Certain methods of training the coffee bushes, cultivating by mechanical means, harvesing the crop, washing channels, elevators and ejectors, mechanical drying, etc., should be adopted wherever possible as a means of saving labour and reducing the cost of production.

(After the paper, a series of lantern slides, illustrating coffee culture in Kenya and Costa Rica were shown.)

Mr. HARGREAVES stated that in the Toro district of Uganda a withering of the tip of coffee was seen. Observations proved that the malformations were due to climatic conditions. Many believe this to have been caused by an *Aphis*, although one planter had cured the condition by shading. He asked what procedure was adopted in Kenya to alleviate this condition, and what was considered to be the cause.

Mr. TRENCH said that the condition was considered to be purely climatic in origin. Mr. Wilkinson had investigated the matter fully, and could find no evidence of insects being the cause. It was entirely cured by adequate shading.

In reply to Mr. Koch, Mr. Trench stated that mist, if continuous, might adversely affect coffee, but that in the Nyeri district the mists that occur in the morning have had a beneficial effect.

Mr. FULLER observed that the shade question must surely be considered afresh in each country. *Grevillea robusta* in Kenya would not be considered " robusta " in Natal, the habit of growth there being often quite different.

THE CHAIRMAN (Mr. Holm) thought that in each area several varieties of trees must be tested before any conclusions could be arrived at; and that having regard to varying conditions and behaviour of different trees it took a considerable time to acquire reliable information.

Mr. SIMPSON said that in Uganda their experience in coffee cultivation had not been a very happy one. The coffee was first planted at about 4,000 ft. elevation and treated on the single stem system. Under those conditions it became worn out early. At the higher altitudes the multiple stem system was being followed and was proving most advantageous. It gave a more even yield and required less pruning than the single stem system. He was sure that the Conference was greatly indebted to Mr. Trench for his paper and his slides illustrating coffee culture.

COFFEE ROBUSTA AND ITS DEVELOPMENT IN UGANDA.

Mr. MAITLAND read the following paper (referred to in the Agenda as T.C.(C)Ag.5):—

Robusta Coffee has now become a crop of considerable economic importance and what I have to say regarding it and its development in Uganda will I hope be of interest.

When we come to consider, during the course of my paper, the comparative exports of coffee we shall see that the exports of Arabica Coffee from Uganda have never been very great and have been stationary if not actually decreasing during recent years. That fact has, I refer more particularly to the Department of Agriculture, caused us to turn our attention to the hardier and more resistent types of coffee and especially of robusta.

I have drawn up my paper, for convenience, under several headings as follows:—

I. Historical, *i.e.*, the history of Robusta Coffee and its rapid rise to economic importance.
II. Comparative exports of Robusta Coffee and illustrating particularly the rapid rise of robusta in Java.
III. Present market prospects.
IV. Robusta Coffee as a particularly suitable crop for Uganda.
V. Treatment of the tree under cultivation.
VI. Robusta Coffee development work of the Department of Agriculture.

I. Historical. One of the earliest if not the earliest reference to Robusta Coffee is that found in Speke's Diary of the discovery of the source of the Nile written as far back as 1863. He states that on approaching Masaka he was met by the Pokino and other natives who brought with them presents among other things quantities of Coffee and adds that this grows on large trees like clusters of Holly berries. There is no doubt of course that this coffee to which Speke refers is the Robusta Coffee of native gardens so familiar to us in Uganda and which has been grown by the natives of Uganda from a very remote period. It was not however referred to in that record of Speke as Robusta Coffee but merely as Coffee. It is a pity that the species was not described then by some botanical authority. It was not until

1898 that the name *Coffea robusta* appeared. That was the name applied to a specimen of coffee sent from Congo to Brussels and discovered there by the Belgian Botanist Emil Laurent. de Wildman describes a Robusta Coffee from the Gaboon as *C. canephora;* Zimmermann of Amani described the Bukoba Coffee *C. bukobensis* and the coffee of Uganda native gardens has been named by some authority *C. ugandae.*

There is a great deal of variation among Robusta plants and that no doubt has led to considerable confusion in nomenclature. Among the trees in native gardens in Uganda one can find trees with long and narrow leaves, others with broad leaves, trees also with very small cherry, others with large. The differences are very marked indeed, so marked that to attach varietal names to them would be quite justifiable.

We have seen that Robusta Coffee has been found in the Congo and Gaboon. These localities are no doubt the natural home of the plant. It extends in its distribution to forest of the Semuliki valley and to the forests of the Western Province of Uganda, where it is exploited by the natives. It is doubtful if it occurs at all as a natural plant in Buganda proper.

I know it occurs in some of the forests of the Lake region and also further inland. I have seen these trees and they appear to me to be too localised and too near habitation to indicate a wild habit; they do now nevertheless exist as wild plants.

The Baganda themselves have a tradition that their Coffee came from the north with their first traditional King " Kintu." In a recent letter from the Agricultural Officer in Southern Sudan I am informed that Robusta Coffee occurs wild in the highlands of Mongalla. So this fact would seem to confirm the theory regarding the origin of their coffee.

Now all this goes to shew that Robusta Coffee is a fairly widely distributed plant under native condition in central Tropical Africa, and when we hear of Robusta Coffee, Uganda Coffee, Bukoba Coffee, and Congo Coffee, we shall know that we are dealing with one and the same group.

In 1902 specimens from a coffee bush 20ft. high in a native garden in Entebbe, were sent to Kew and were described as Robusta Coffee.

The discovery of robusta in the Congo in 1898 was very opportune, as the great Coffee producing countries of the East were looking for a hardy type to take the place of the Arabica Coffee, the exports of which were being gradually diminished owing to the blight *Hemileia vastatrix.* In this connection I shall quote from the *Tropical Agriculturalist,* Vol. 44, 1917, page 314.

> When the blight in Java appeared coffee-growing was one of the most important industries in that island, and after the plantations had been destroyed by the disease, the Dutch Government having failed to control the blight by repressive measures, instituted investigations with a view to discovering a blight-resistant coffee, in the course of which work several species were introduced and tested. Among these were Liberian coffee *(Coffea liberica)* and robusta coffee, considered by WILDEMAN to be a variety of *Coffea canephora.*

Robusta coffee was discovered in the Belgium Congo, and seeds were sent to Brussels, Belgium, and propagated where plants were first offered for sale in 1911. Some of these plants found their way to Java. Like most new introductions the robusta coffee was at first looked upon rather askance, but as its greater climatological range as compared with that of Arabian coffee, and its productivity, precocity, and resistance to the coffee blight *(Hemileia vastatrix)* became apparent, it rapidly gained popularity, so rapidly in fact that the Javanese coffee plantations to-day consist almost entirely of robusta coffee. 298,774 acres or 83% of acreage under Coffee (1919).

These are significant facts and appeal very strongly to us. They are an indication of the trend events should take regarding coffee in Uganda for we have had an almost parallel experience with arabica.

We might now consider the comparative exports of Robusta Coffee from Java, where the rise has been phenomenal, and from Bukoba (Tanganyika) and Uganda where Robusta is known to have existed for many many years.

In 1900 the export of arabica coffee from Java was 37,000 tons; by 1925 the export of this coffee had dropped to 7,800 tons; meantime (1919) Robusta exports were 213 tons, and by 1925 61,000 tons, having almost swamped arabica.

In view of these facts we might well ask why since we (Uganda) claim to be a coffee producing country our exports of that commodity are so meagre. The answer is easy, we have until recently neglected Robusta Coffee.

These export figures now lead us on to a consideration of market prospects of robusta. 61,000 tons, the export from Java and neighbouring islands, is a very considerable quantity, and there must be somewhere a good market for this commodity. Apart, however, from that view of the matter I should like to emphasise the fact that on the markets Robusta Coffee can stand on its own merits. I refer of course to Robusta of a high standard. That would have been a very bold statement to have made say 10 years ago; but the temper of the market has changed. In connection with this point I shall quote an authority on the matter. In " All about Coffee," page 145, we read:

> Viehoever and Lepper carried on (1921) a series of cup tests of robusta, the results as to taste and flavour being distinctly favourable. They summarised their studies and tests as follows:
>
> "The time when coffee could be limited to beans obtained from plants of *Coffea arabica* and *C. liberica* has passed. Other species, with qualities which make them desirable, even in preference to the well reputed named ones, have been discovered and cultivated. Among them, the species or group of Coffee robusta has attained a great economic significance, and is grown in increasing amounts. While it has, as reports seem to indicate, not as yet been possible to obtain a strain that would be as desirable in flavour as the old ' standard ' Coffee arabica, well known as Java or ' Fancy Java ' coffee, its merits have been established."
>
> The Botanical origin is not quite cleared up, and the classification of the varieties belonging to the robusta group deserves further study.

As is usual in most of the coffee species, caffein is present. The amount appears to be, on an average, somewhat larger (even exceeding 2.0%) than in the South American coffee species. In no instance, however, did the amount exceed the maximum limits observed in coffee in general.

Due to its rapid growth, early and prolific yields, resistance to coffee blight, and many other desirable qualities, Coffee robusta has established " its own." In the writer's judgment, robusta coffee deserves consideration and recognition.

This is a statement of great interest because it comes from America, where it would not be surprising to find a strong prejudice against robusta, arising from their large controlling interests in Santos coffee.

Further, when we view this statement in conjunction with the export figures from Java we see that Robusta has made a bold entry into the coffee markets of the world.

I myself have had the opportunity of meeting Brokers and Produce Merchants in London and also Mincing Lane tasters and have been assured that there is a good market in London for good robusta. We have had enquiries about Robusta from Egypt, Palestine, Poland, Germany, and other parts of the continent and New Zealand. Indeed the prospects are becoming so well recognised that we have had requests for seed of our Uganda types from various countries. Of course, the final test of a coffee is its liquoring qualities. We have seen that Robusta is not lacking in this respect. By selection it has been possible to improve on the size and boldness of the bean and a great deal more can be done.

I hope I shall not weary you if I quote anent this matter of market prospects a rather striking statement from the *Planters' Chronicle* of September, 1925, entitled " The Outlook for Coffee in the East." It is as follows:—

The *Stephanoderes* pest whose ravages on Brazilian Coffee were described on page 509 of our issue of July 25, has an economic significance which augurs well for the future of the coffee growing industry in the countries outside Brazil. The outlay required to keep this scourge within bounds is involving no less than an increase of five American cents per pound on production costs. In other words the margin of production costs has swung round in favour of non-Brazilian Coffee growers; who presumably are now benefitting from the enhancement of the world price of coffee by which the producers of Brazil are enabled to combat *Stephanoderes*. This procedure of passing extra production costs of an article on to the consumer and thus avoiding diminution of profits is of course only practicable for producers who, like the Brazilians, control a predominant proportion of the world supply.

Again, even in such circumstances, it has its obvious limitations; for any advance towards prohibitive prices—unless, of course, the current rate of consumption by the consumers of the commodity concerned is already at an absolute minimum—is bound to cause a falling off in demand, which may quite well be

sufficiently great to nullify completely all effort to keep prices up, and in the event even bring them down to a level lower than actual production cost.

Production monopolists in general therefore can only arbitrarily force the price of their commodity which is so essential to the life of the community that it is beyond the power of the consumer to modify the demand. Furthermore, the position of the Brazilian Coffee producers in particular is rendered more precarious by the existence of many other sources—potential as well as in no inappreciable measure actual from which coffee may be obtained.

This means that if the Brazilians continue their policy of forcing enhanced costs on to the consumers, those consumers will be all the more ready to resort in self-defence to retaliatory tactics on the lines indicated above. For if they find that the coffee they require can only be obtained from Brazil at a very inflated price, they will turn their attention to other countries where coffee can be grown which will undersell Brazilian and yet leave producers' profits satisfactorily high.

Such a position of affairs is well within the bounds of possibility, and would undoubtedly awaken an increased interest in the coffee markets of the East. Satisfactory prices on a consistently remunerative level would be ensured, for the Brazilian producers—owing to the cost of combating *Stephanoderes*—are no longer in a position temporarily to cut their prices down to a level below that at which their competitors can profitably produce. Indeed the boot would be on the other foot; for it would appear that a price is quite practicable which would give a satisfactory profit to countries untroubled by *Stephanoderes* while entailing a loss for producers involved in an Anti-*Stephanoderes* campaign.

It is an ill wind which blows nobody good, and it would appear from the statement I have quoted that the misfortunes of the Brazilians from the ravages of *Stephanoderes* is going to open up new markets for coffee growers outside that country.

The Brazilians will no doubt do their utmost to maintain their position and might very likely be successful along the lines the Java authorities adopted, under similar stress of introducing the parasite of the *Stephanoderes*. In the meantime other coffee producing countries have an opportunity of gaining an entrance into the markets.

Robusta as a crop for Uganda.

I should like now to say something with respect to Robusta as a suitable crop for Uganda. I have already observed that Robusta has a wide distribution as an indigenous plant within our borders and adjoining territories, and I think we may claim with a great deal of justification, Uganda as the home of Robusta. It was grown by the natives long before the advent of the European in Central Africa so that we are not dealing with a plant in an experimental stage. But apart, however, from its suitability in that respect and its resistance to the major pests which attack arabica in the country, it is a plant admirably adopted to native cultivation. I have argued before now

that a great number of plants could be distributed to peasants and grown by them without unduly interfering with their ordinary agricultural pursuits. We see the ordinary robusta growing in twos or threes around native compounds, thriving without much attention or care, but of course being amply nourished by a mulch of old banana stems and other vegetable waste. These are ideal conditions I consider on account of the gross feeding nature of Robusta. It has a further suitability to native conditions which I consider of very great importance. It is this, the tree if left to grow *ad libitum* will develop into a perfectly balanced tree, always producing fresh primaries capable of carrying heavy crops. I do not think that you will find on a naturally developed tree any secondary growth or other superfluous wood.

It follows therefore that the native can plant the tree, give it ordinary care during the early stages, and then leave it to look after itself. It has still a further advantageous character from the point of view of suitability to native cultivation, in its long cropping period. Unlike *C. arabica* you do not have the bulk of the crop coming on all at once and having to be picked within a few weeks. The ripening is gradual, rising to a maximum cropping period round about December-January-February, usually a slack period in field work. There would be no undue rush with the harvesting and probably much less wastage than there might be if the crop had to be handled within a short time. I think these remarks all apply equally to the crop under European management. I see no reason why Robusta could not be allowed to grow *ad lib.* under plantation conditions; the system would answer perfectly. With wider spacing than that given to Arabica the trees could be allowed a free development and in about ten years or so would reach their maximum vegetative development. Then with ordinary cultural treatment they would remain so, yielding year by year, for a generation and more. I have had trees in native compounds under observation for the past 12 years and they appear to be the same to-day as when I first saw them; they do not seem to have increased in diameter or height, but they have been yielding year in and year out. Picking the cherry from these large trees is not a matter of great difficulty. Many of the branches can be pulled down, and many of them are low enough to be picked in the ordinary way. Small steps will facilitate the picking of the high branches.

This brings us to the treatment of the tree, and I should say at once that I am opposed to pruning where robusta is concerned. In commenting on the low yields of our Robusta in the Annual Report of the Department of Agriculture, Uganda, for the year 1922, I made the following statement:—

"These are undoubtedly low yields for Robusta and they are too poor to be accounted for by the incidence of low yields following high. The fault lies, it would appear, in applying the system of pruning coffee arabica to these trees; they will not accommodate themselves to it, and from our experience we would recommend that Robusta be allowed to grow *ad lib.*, or at least abandon to a very great extent the drastic prunings practised on the trees hitherto." I would add to that statement by saying that the maximum yields from Robusta can be got only by allowing the normal development of the tree.

This diagramatic sketch* will be of interest in this connection and show clearly what I mean. It has been sketched from an actual tree and you will observe how the strong suckers which have grown up through the main axis of the tree have been bent over by weight of crop and are themselves producing suckers which have in turn been bent over, an *ad infinitum* process. Here I might add that this particular tree yielded 31 lbs. of clean bean from the main crop between December, 1925, and March, 1926. It is a tree with a large cherry and a bold bean, and one of the selected trees. It has borne a large cherry right throughout the crop. It is an exceptional tree in respect to its large cherry and bean but not particularly in its vegetative development. These large trees are usual in native gardens or shambas when they have half a chance. I think the secret of the wonderful development of these trees is the large amount of humus in the soil; they like this for they are gross feeders.

Coffee Robusta development work of the Department of Agriculture.

I shall refer now to the Coffee Robusta development work of the Department of Agriculture. Our serious work in Coffee Robusta dates back to 1916. We have had under test a wide range of robustas, as for example *Toro robusta*, *Java robusta* 78 and 104, *Canephora*, *Quilou*, *Bwebza*, and *Bwamba*, *Bukoba*, and several local types, and they are all pretty fully dealt with in Circular No. 11 issued by the Department of Agriculture. From amongst these types samples were prepared for liquoring tests and market value. Many of them were reported to be of poor quality and worthless but our No. 9 proved to be a satisfactory product, and I will quote the expert's report on it. "The present sample represents a very desirable type of coffee, which would be quite suitable for consumption in the United Kingdom; consignments of similar quality would always be readily saleable in London." The experts who carried out the roasting trials had previously reported on all samples of Robusta from Uganda forwarded recently to the Imperial Institute and they stated that the present sample was by far the best of the series. They suggested that it would be desirable to use this seed for propagation in Uganda. We have stuck to this type ever since. It was our aim to obtain the best material we could get to begin with and improve on that if possible. Our next concern was to obtain a large and bold bean and we have that, I think, in our No. 9 Selections, etc. Let us refer to the samples of coffees which are set out on the sheet here (see photograph*). I think you will find them of very great interest, for the disparity is shown between the ordinary native type in Uganda and between Bukoba coffee and our No. 9 Selections. It is encouraging to note how superior our No. 9 Selections are to those ordinary types and how favourably they compare with Uganda arabica.

The beans on the sheet are set out in spaces of equal size and there are a hundred beans in each space, set out side by side. You will notice that the Bukoba coffee and the ordinary robusta of Uganda take up only about half the space of No. 9 selections and the space occupied by No. 9 selections and Kinawa selection is about the same, a little less than that taken up by an ordinary sample of plantation arabica.

* Not reproduced.

The sheet has a further interest because it shows the weight in grammes of a hundred beans of the respective types. The following figures speak for themselves:—

WEIGHT IN GRAMMES OF 100 SEEDS.

1	2	3	4	5	6
Arabica (normal)	Java robusta (graded)	Uganda robusta 9/15	Uganda robusta 9/19	Uganda robusta 9/8	Uganda robusta 9/6
19.1	19.60	20.35	20.92	20.18	19.30

7	8	9	10	11	12
Arabica (normal)	Bukoba robusta	Uganda robusta (ordinary)	Uganda robusta K.selection.	Uganda robusta Enoka II.	Uganda robusta Enoka III.
19.1	11.20	15.76	20.00	15.25	15.00

NOTE.—K—Kinawa selection. This and Enoka II. and III. are pronounced varieties from native gardens.

These selections are the types of Coffee with which we are endeavouring to build up the Robusta industry in Uganda. You will have observed the extreme variations in the beans so that it is important to get something uniform. That has been a difficulty because supplies of good seed have been limited, and, owing to the fact that fairly good prices have been got during the last couple of years for quite ordinary coffee, planters have been inclined to plant up any kind of robusta. That is a great mistake I am sure, for robusta cultivation is bound to extend not only in these territories but in others and outside the Empire, prices will become competitive, and it is therefore important to grow only the very best.

The object of the Department of Agriculture was originally to built up a native industry, but that was because European planters would hardly touch Robusta. The Department has raised plants in nurseries of its own and has already distributed free some hundreds of thousands of plants. During the next planting season something like 500,000 plants will be distributed.

Now the European planters are realising the importance of Robusta and we have not been able to meet the demand for plants and seed for them. However, we have been able to help to build up small areas from 10 to 50 acres as further seed supplies are obtained and presently there will be ample available.

Mr. RITCHIE, asked how the characteristic of a long picking period, which according to Mr. Maitland's statement, made the crop a suitable one for native cultivation, affected the incidence of the bean borer, and Mr. Hargreaves stated that he considered that the fact of having a long picking period was advantageous.

In reply to Mr. Ritchie, Mr. Maitland stated that there was no die-back in *Robusta* after a heavy crop: there would probably be die-back with *Arabica* but he was inclined to attribute that to the effects of leaf disease.

Mr. RITCHIE observed that of course, one might get considerable leaf cast due to debility and with no *Hemileia* present.

Mr. SIMPSON said that in regard to coffee cultivation, Uganda was divided into two distinct zones—those at an altitude of from 5,000 to 6,000 feet, where *Arabica* was grown, and the lower areas at about 4,000 feet where *Robusta* now was being grown. They were now returning the natives to the Sesse Islands, whence they had been removed owing to the incidence of sleeping sickness, and those islands were now being developed agriculturally entirely as areas for the growing of *Robusta* coffee.

THE CHAIRMAN (Mr. Holm) was much concerned in regard to the possibility of the spread of *Stephanoderes hampei* from Uganda, and asked if Uganda was making any attempt to prevent such spread to new districts, and, if so, if they entertained any hopes of being successful. He hoped that the Entomological Section of the Conference would discuss the question of preventive measures in regard to the spread of this coffee pest in East Africa.* He expressed his appreciation of the valuable paper which Mr. Maitland had just read.

Mr. HARGREAVES said that in Uganda, *Stephanoderes hampei* occurred in all coffee areas, and it had recently appeared in the Elgon district. He was doubtful whether it would be possible to exercise complete control over this pest, and it appeared probable that in the long run it would spread into Kenya in the Elgon area. The incidence of attack seemed to be somewhat reduced in cases of Robusta coffee. He did not think that there was any danger of introduction of the pest from seeds, if they were properly inspected and fumigated.

Mr. ANDERSON said that in Kenya they were much concerned with regard to the spread of this pest from Uganda, particularly in view of the fact that coffee cultivation on the eastern slopes of Mount Elgon was developing rapidly.

Mr. HARGREAVES was afraid that they could hold out little hope that the pest would not spread.

THE CHAIRMAN (Mr. Holm) asked if they were considering if it were possible to assist, by artificial means, parasites to render natural control of this pest.

Mr. HARGREAVES thought, personally, that the damage done by *Stephanoderes hampei* on *Arabica* coffee would, to some extent, be reduced if a small percentage of *Robusta* trees were planted among the *Arabica*. This was merely a theory of his own, and it had not yet been tested. An experiment for this purpose had been commenced.

In reply to Mr. Holm, Mr. Hargreaves further stated that he had been endeavouring for six years to obtain data of use in devising control measures for the pest, but so far he had been unable to evolve a successful method.

Mr. Kirby then proposed a vote of thanks to Messrs. Trench and Maitland for their excellent papers.

* See Part IV., Chapter III.

CHAPTER V.—LIVE STOCK INDUSTRY. *

REGISTRATION OF CATTLE.

Mr. VANDEN ABEELE said that it was desirable that every Colony should make provision for the registration of all cattle.

The institution of Herd Books for all pure bred cattle would be a good step in the way of progress. A special inter-Colonial Commission could, perhaps, determine the standard points of the different breeds of Stock in South and Central Africa; and perhaps a definite model for Herd Books could be adopted internationally. In this way when an animal was imported, the entry in the Herd Book of the country of origin, supported by a certificate from the competent authority in that country would suffice to ensure entry in the Herd Book of the importing country.

It was suggested, for consideration, that the records of pedigree stock should be authenticated in order to prevent fraud.

(The above was circulated in the form of a note under T.C.(C)Ag.21.)

THE CHAIRMAN (Mr. Holm) observed that machinery existed for the registration of all kinds of pedigree stock, both East African and South African and that it could truly be said that the pedigree records published in the Stud Books could be relied upon. Recently in Kenya, under the auspices of the Agricultural and Horticultural Society, an East African Stud Book making provision for the registration of all kinds of pedigree stock in East Africa had been instituted. The work was supervised by the Stud Book Committee, the Chairman of which was the Director of Agriculture. It seemed to him, therefore, that as far as South and East Africa were concerned, purchasers could rely upon the information published in these Stud Books. The expenditure involved in the publication of a Stud Book was not justified unless there was a large number of stock to be dealt with.

Mr. VAN DEN ABEELE enquired as to the registration of native cattle and standards.

THE CHAIRMAN (Mr. Holm) said a standard of points for native cattle could be drawn up, but having regard to the illiteracy of the native population, he did not think that this organisation at the present time would be practicable; it could only be done by educated and intelligent breeders.

Mr. VAN DEN ABEELE stated that in the Belgian Congo it was proposed to introduce it for native cattle; they were more interesting and important and moreover more resistant to disease.

THE CHAIRMAN (Mr. Holm) said that improvements might be effected in their cattle by the application of these principles of breeding and selection, but it did not appear that an inter-Colonial Commission to go into the matter with a view to fixing upon a suitable standard would be of any real value. There were many types of native cattle in Africa.

Mr. VAN DEN ABEELE said Katanga and Rhodesia had the same types.

* See also under Part V., Chapter I.

THE CHAIRMAN (Mr. Holm) said that if the Katanga Government wished to fix a type in that part of the country, herds of the better class of animals would have to be established, and breeding carried out systematically. After a time, a breeding history with records would be obtained, the type would become fixed, and the cattle might be registered in a Herd Book.

Mr. Holm then quoted his experience in connection with the establishment of the Herd Book for " Afrikander " cattle in South Africa.

Mr. VAN DEN ABEELE enquired as to the records of Rhodesian cattle.

THE CHAIRMAN (Mr. Holm) stated that the machinery existed. A registration certificate was obtainable from the breeder, giving particulars of the animal's pedigree, and these could be entered in any new Herd Book, compiled and published in the Belgian Congo.

COST OF PRODUCTION OF MILK AND BUTTER FAT.

THE CHAIRMAN (Mr. Holm) said that he had procured some information with regard to these questions. He did not know whether other countries could give more information and it was admitted that that which he had been able to secure through the good offices of farmers in Kenya might not be complete nor strictly accurate in some respects. Agricultural costing demanded very careful handling by experienced men specially trained and an extended enquiry was necessary before accurate figures could be arrived at.

The information furnished by representative farmers could be summarised as follows:

Cost of producing 1 gallon of milk—feeding with concentrated food plus pasture in order to maintain a town supply throughout the year: Average cost over four years: Shs. 1/6 per gallon.

THE MEAT INDUSTRY.

THE CHAIRMAN (Mr. Holm) said the general remarks given above as to the difficulty in obtaining accurate figures of Agricultural costing applied also to these questions

The following figures were approximately correct:—

Including every possible charge (*e.g.*, management, grazing, depreciation on fencing, importation of bulls, etc.) and taking an animal as 7/8 or 15/16 grade, the cost of production of an average five-year-old steer was £5.

Dressed carcase (grass fed) averaged in weight 600lbs.

In one of the pastoral areas, with an average rainfall of 24 inches, the carrying capacity was 1 sheep per 1½ acres, and 1 beast per 10 acres.

COUNTRIES FROM WHICH PEDIGREE STOCK IS CHIEFLY IMPORTED INTO KENYA AND INFORMATION AS TO REBATES (IF ANY) ALLOWED FOR TRANSPORTATION (INLAND AND OCEAN).

(Colonel R. B. Turner, C.M.G., D.S.O., Trade Commissioner for the Union of South Africa, was present during the discussion on this subject.)

THE CHAIRMAN (Mr. Holm) said that cattle were imported into Kenya from Great Britain and South Africa; sheep from Australia. There were no " rebates " made on freight, but representations had been made to shipping companies who had twice made some reductions within the last three or four years. The freight from South Africa was not unreasonable, but having regard to the services rendered, that from Great Britain appeared to be excessive. A special low railway freight rate in Kenya was in force for pure-bred stock, but landing and agency charges at the port swelled the cost per head very considerably.

COL. TURNER presented the following statement of freight and extra charges from Durban to Mombasa. He said that, in view of the fact that the Union Castle Company carry pure-bred stock free to South African ports, some better arrangements might be made with steamship companies serving East Africa:—

FREIGHTS ON LIVESTOCK—DURBAN TO MOMBASA.

CATTLE.—5 OR MORE HEAD:

	£	s.	d.	
Present shipping freight by Conference Lines	8	0	0	per head
Fittings on Ship	2	0	0	,, ,,
Chief Officer gratuity, about	1	10	0	,, ,,

SHEEP AND SMALL STOCK.—10 HEAD AND OVER:

Shipping freight	12	6	.. ..
Pens, at rate of	4	6	.. ..
Gratuity to Chief Officer, at rate of	2	6	.. ..

In addition to the above, the following costs are also entailed:

Wharfage, Compound Fees, Feed, Attention, Veterinary Fees and Attention, Agency Fees, Cables.

To take two specific cases:—

(1) 8 cows and bulls—Durban to Mombasa.

ACTUAL COSTS:	£	s.	d.
Freight @ £8 each	64	0	0
Fittings @ £2 each	16	0	0
Wharfage, compound fees, Veterinary services, and attention fees	17	17	5
Chief Officer Gratuity	9	9	0
Fodder	7	18	0
Cables	1	11	6
B/L agency fees and commission	3	8	5
	£120	4	0

or an average cost of £15 per head.

(2) 125 sheep—Durban to Mombasa:

Freight @ 12/6 each	78	2	6
Wharfage	10	12	8
Compound fees	17	6	6
Gratuity to Chief Officer	15	0	0
Cost of pens	27	6	7
Feed	37	9	1
Cables	2	3	0
Attention	27	16	0
Veterinary attention and fees	4	4	0
Commission	3	16	2
Agency and stamps B/L	2	11	8
	£226	8	2

or an average cost of £1 16s. 3d. per head.

Number of Cattle and Sheep imported from Union of South Africa into Kenya.

	1925. £		1924. £	
Bulls	2,255	(100)	... 100	(9)
Cows	833	(24)	... nil	
Horses	1,373	(32)	... 350	(?)
Sheep	108	(13)	... 1,310	(170)

Total Imports.

Bulls	5,005	(110)
Cows	895	(29)
Horses	2,533	(50)
Sheep	2,633	(228)

The following freights on livestock from England were quoted:—

Freights on Livestock—England to Kilindini.

From England to Kilindini the freight rates were, at the end of 1924, by Conference Lines:—

Horses:	1	£56	14	0
,,	2/3	£52	10	0
,,	4/9	£51	9	0
,,	10/25	£50	8	0
Cattle	1/9	£45	3	0
,,	10/25	£42	1	0
,,	26 and over	£40	19	0
Sheep	1/5	£13	10	0
,,	6/19	£12	15	0
,,	20/30	£12	10	0

The above rates are per head and include fodder, water, and the use of boxes or pens.

The lighterage charge at Kilindini is, on cattle, Shs. 10/- per head; and on sheep, Shs. 2/- per head. Charges for cranage and wharfage are Shs. 1/50 and Sh. 1/- respectively.

After discussion the following Conclusion was adopted:—

(a) On the statement presented by the Trades Commissioner for South Africa, it is noted that the freight and other charges on stock imported from South Africa are considerable and it is requested that the Trades Commissioner should make representation with a view to effecting reductions.

(b) It is considered that the rates on livestock from England to East African ports are excessive, are limiting the importations of stock, and are, therefore, retarding livestock improvement in East African Territories. It is therefore urged that representations be made to the Shipping Companies requesting that a substantial reduction be offered.

THE COMPULSORY DIPPING OF CATTLE BY NATIVES.

(Colonel Doherty, Chief Veterinary Officer, Kenya, was present during the discussion.)

Mr. VAN DEN ABEELE stated that they had made attempts to compel the natives to dip their cattle. They had experienced difficulty in establishing legislation towards this end. At the present time, the natives were encouraged to dip, but no legislation existed. His Government desired to know what action had been taken in other countries in connection with native stock. In certain parts of the Belgian Congo the Europeans were compelled by law to dip their cattle.

COL. DOHERTY stated that he was glad to give any advice or place any knowledge possible on this subject before the Conference. He stated that, as delegates knew, the Pan-African Veterinary Conference met and discussed veterinary matters with great benefit and he felt sure that the Agricultural Conference would supply valuable information. With regard to the dipping of native cattle in reserves, each problem as it arose should be considered on its merits. It was impossible to lay down any broad principles to be followed throughout the country; there were differences of climatic conditions, pasturage, rainfall, environment, and especially the incidence of disease. It was not possible to lay down any general policy, but if Mr. Van den Abeele would specify the conditions under which his Government desired to enforce dipping he might be able to help them.

CAPT. SHEEDY stated that in Tanganyika they had found that in whatever centres properly organised and supervised dipping tanks existed, they had found no difficulty in persuading the natives to take advantage of them when they found that it resulted in a decrease of infection, and a diminution in loss of stock. Compulsory dipping was enforced by the Chief Veterinary Officer in such areas as were considered necessary. Such measure was applied to all stock and not confined to native-owned animals. No system of universal compulsory dipping was yet practicable. Each tank in the remote parts of Tanganyika Territory cost £400 and water was very scarce in many areas.

THE CHAIRMAN (Mr. Holm) said that he would like to have an expression of opinion as to whether compulsory dipping was practicable or advisable unless it was carried out universally and noted the effect which dipping might have upon the immunity of native stock to tick borne diseases.

Mr. VAN DEN ABEELE said it was the difficulty of universal application which had suggested to his Government that the matter should be brought before the Conference, as it had appeared to them useless in certain countries to introduce pure stock unless dipping was made universal.

THE CHAIRMAN (Mr. Holm) stated that in regard to Kenya no compulsory dipping existed, either for native or for European stock. The Cattle Cleaning Ordinance was passed in 1920, but it was recognised that the element of compulsion should not be applied until Government could give financial assistance in cases where the farmer was unable to erect a dipping tank without aid.

Mr. VAN DEN ABEELE said that it was the desire of his Government to build dipping tanks at Government expense.

COLONEL DOHERTY suggested that perhaps what the Belgian delegate desired was to establish comparisons between the value of dipping applied to Europeans and the native reserves respectively. It was quite evident that dipping was useless unless the Government was able to control the movement of cattle, as it was possible for Europeans to maintain clean pastures with fencing and dipping while infection existed in the neighbouring areas.

Mr. VAN DEN ABEELE referred to differential legislation in respect of the dipping of cattle and Mr. Holm said that it seemed to be quite useless to force one class of stock-owners to dip their cattle, and not the other and that unless it was made universal to all stock-owners, native or European, in the same district good results could not be obtained.

COL. DOHERTY stated that dipping without fencing was very unsatisfactory, even when an attempt was made to control East Coast fever on a single farm.

Mr. WORTLEY emphasised the importance of controlling the movement of stock.

COL. DOHERTY pointed out that in most cases the boundaries between permanently infected and non-infected areas were natural boundaries and that the incidence of East Coast fever was governed by the ability of the tick to maintain itself uninterruptedly; this depended on conditions of moisture and warmth.

Mr. WORTLEY said that in the southern area of Nyasaland they had cleaned up an infected area and made dipping compulsory. The European farmers allowed the natives to use their tanks on payment.

THE CHAIRMAN (Mr. Holm) stated that in certain native areas in South Africa compulsory dipping was laid down. Stock Inspectors had been appointed to see that natives brought their stock regularly to the Government dipping tanks, and he had learned that in Natal and Transkei this procedure had been very successful.

The following Conclusion was adopted:—

> That under existing conditions the compulsory dipping of cattle by natives is, at present, impracticable over extensive areas.

CHAPTER VI.—NATIVE AGRICULTURE.

(Items in this Chapter were discussed at joint meetings of the Agricultural and Cotton Sections.)

NATIVE AGRICULTURE IN KENYA, IMPROVEMENT, ETC.

The following paper by Mr. E. Harrison, Deputy Director of Agriculture, Kenya, was read (paper referred to in Agenda as T.C.(C)Ag.3):

Naturally this is a problem of more than ordinary interest to Kenya Colony, and it is a peculiarly difficult problem on account of the many and varied kinds of interest taken in our natives and their reserves. It is a matter with which Departments of Agriculture in similar Territories are very much acquainted and it is hoped that a statement of our position with a sketch of what we are trying to do and what we hope to evolve will give grounds for discussion by and an opportunity for advice from those attending this Conference.

Almost the greatest asset possessed by Kenya is its native population and it is an asset which may be realised fully only if its development is undertaken seriously and continuously. With people the wealth of the land may be rendered available so that progress of Kenya may be said in great measure to be bound up in the development and organisation of the people and of the fundamental industry of the major population.

Briefly, Kenya natives are said to fall into two categories, namely, Pastoral and Agricultural tribes. At least most, if not all, tribes are pastoralists, but some have been induced by circumstance to take up agriculture. There is a slow process of differentiation going on so that we hope we shall find our pastoralists settled in pastoral areas and our agriculturists using all the agricultural areas in the reserves. At present, to cite two cases only, the Nandi and the Lumbwa are two tribes, inhabiting agricultural areas, whose agricultural effort is meagre in the extreme, their interest being centred on livestock.

The Colony falls into five main divisions in respect of its native population:

(1) Nyanza Province: This I should term an agricultural province, although great numbers of stock are kept, and the Nandi and the Lumbwa above mentioned are included in this area. On the whole agricultural work is bound to increase in Nyanza.

(2) Kikuyu: This is an agricultural area, but here again great numbers of stock are kept.

(3) Masai-Ukamba: Mainly pastoral areas.

(4) The Coast: Agricultural for 10-30 miles from the sea, behind that pastoral.

(5) The Northern Frontier District: Purely pastoral.

The pastoral areas are in the drier areas of the country and the people live a semi-nomadic if not an entirely nomadic life. Of the pastoral areas the highest degree of settlement is found in the Ukamba Reserve which is partly agricultural, and it is expected that more agricultural work will be carried on in the Ukamba Reserve, particularly if the grazing areas of the tribe are not extended.

The greatest measure of nomadic existence is found in the Northern Frontier District followed by the conditions in the Masai Reserve. It is generally found that the trekking of stock is the rule and only when you find livestock in connection with agriculture do you find the cattle on the same grazing all the year round.

In the Kerio Province cattle are run in the hills for the greater part of the year, being brought to the plains about the middle of the rainy season. There is much to be said for the movement of cattle from grazing to grazing. In this way natives escape the onset of disease—they run from it. Change of pasture too is a good thing for livestock, as any deficiencies in the one pasture may be made up when the stock are on other pasture. The semi-annual trek to a famous salt lick is also of great value to cattle; during the move they traverse different grazing and at the same time their old pasture is given a rest which may help in its recovery.

Under European control on large ranches the resting of portions of the ranch is systematised, and the provision of licks and earthy salts which are of value to stock is given attention. In his wilder way the native does what he is able, but he has not yet seriously attempted to increase the carrying capacity of his country by the construction of dams or the sinking of wells. Nor does he bring licks to his cattle; he prefers the cattle to move to the lick, running the risk of entering a stricken area, or of his cattle mixing at the lick with infected cattle from elsewhere.

In the Kikuyu area, generally, many natives have but few stock; they are mainly agriculturists and have evolved a system of planting mixed crops, including legumes. At the same time they have numbers of goats and some of them besides having cattle in their agricultural area, possess stock which is run on extensive grazing grounds elsewhere. In the Fort Hall area where the pressure of population is moderately high, the numbers of livestock are also very high due to the possession of sparsely populated and large grazing grounds.

The population, in many areas, denuded the land of its timber, and fortunately any further eating into the forest is to a large extent prevented by numbers of wild pig. Gardens too near the forest are endangered by its presence. There is but little attempt on the part of the native to plant trees; he also permits bush to overgrow his old garden after it has been used for a few years and he prefers to plant on new forest soil. In other words, the native is found to be a wasteful but a great clearing agent. Where the population is heavy the percentage of cultivation to land occupied is moderately high, but where there is an abundance of new land to be gained by destroying wood land there appears to be a large abandonment of garden land and new planting is found in timbered country. This state of affairs exists, but increase in population and the enforcement of forest protection laws makes the native go back over the land he once worked. It is a great pity that pasturage is not always formed by this process, bush in the damper areas soon overshadows the grass.

In Kavirondo, as in Kikuyu, there are areas in which large stretches of country are under crop, but even there room is found for goats and cattle in the locations. As livestock is a form of currency and a bank and is closely connected with native marriage and other customs, the possession of livestock is of great importance to a tribe

and to an individual. Thus a successful native agriculturist is ever tending to become a pastoralist, just as a successful business man ultimately is found to possess investments in the "funds" and to have an income and a reserve apart from his business. We know that this method of investment of surplus wealth ultimately would destroy agricultural work were it not for the fact that disease periodically reduces the numbers of cattle, permitting the over-grazed land to rest and agriculture again to flourish.

The tenure of land in native reserves is of such a nature as to restrict development in one sense, whilst in another to assist it. Generally speaking a man is able to find land on which to work but, within limits, any appearance of extensive agricultural work results in the man's activities being curtailed. With old men who appear to have control of much land the incentive to produce a considerable surplus is not great and land which may be utilised for agricultural work is frequently held up by owners for their pleasure or their livestock.

Thus we have large numbers of people inhabiting our so-called agricultural reserves, viz.: Kikuyu and Nyanza, settled, many of them, on most excellent agricultural land, provided in both cases with railway facilities, served to some extent by traders, and peaceably inclined. In parts the pressure of population is very great and for various reasons the surplus population is not able to spread out over equally good land in the possession of another tribe or sub-tribe. In addition to the slowly educative forces exerted by traders and administrative officers, numbers of these people, men mainly, go out to work in areas in which European production has reached a high standard or they work in the transport, building, or household services. This ought to speed up the adoption of western methods and ideas.

Kenya has for its main businesses agriculture and transport. There is no mining and practically no industrialism. It is the business of Kenya to move not only its own products, but also those of Uganda and some of those of Tanganyika. The business houses operating in these Territories are mainly conducted from Kenya. A number of native people are engaged in clerical employment and as porters in towns where large stocks are kept and broken down for distribution. A large income accrues to Kenya from these transport operations. It should be noted that Kenya Estates and Corporations operating within the borders of Kenya may not recruit labour in Tanganyika, nor are many labourers recruited in Uganda for service in Kenya.

It is not possible then to give an estimate of the drain on Kenya's labour resources to maintain the traffic of East Africa. The number of labourers required for a fair development of European areas in Kenya is calculated as follows: Of the five million acres alienated, it is computed that not more than one and a half millions may come under the plough. Of the areas which on present information may be alienated in the future less than 10 per cent. will be cultivable. Therefore one may take the acreage of 1,500,000 as a fair agricultural development in European areas. To work this area we shall need 250,000 daily labourers. Here one assumes the progress of every type of farming, coffee, sisal, maize, etc.,

For transport, household, pastoral and Government work we shall require a further 150,000 people so that we will need 400,000 men for work in the Colony.

We may say we have a population of two and a half million natives. Of this two and a half millions, half a million are computed to be men of working age, but on account of disabilities we cannot expect more than 370,000 will be available. Of this number one half or 185,000 is given as a maximum figure available to-day at one time for work in the Colony.

It is obvious whatever else we may do that we should endeavour to fill up the empty spaces in our reserves with people, that we should educate them in hygiene, in the production of foodstuffs in those agricultural arts which are required when the pressure of population becomes too great for a pastoral system to support. In former times we saw the great treks made by people who wished to get away from restraint. To-day the native areas being delimited, escape cannot be made in this way so that the human being has to accommodate himself and his system.

Now why should we develop field husbandry? Agriculturists are, generally speaking, a fixed population. They are easier therefore to administer. The products of field husbandry may be marketed in the raw state or by a simple industrial process such as ginning; they may be rendered more suitable for transport and for marketing. The capital required to produce one shilling's worth of surplus produce from field husbandry is but a tithe of that required to produce the same surplus from animal husbandry. Field husbandry, properly managed, results in a surplus of foodstuffs, fixed abode, civilisation for the mass. With field husbandry enough animal husbandry may be carried on to supply the wants of the farmers and that without very much interference with their agricultural activities. In Kenya especially field husbandry was encouraged because the machinery for marketing was ready to hand. The marketing of the products of animal husbandry, save of the skins and hides, requires special equipment because the material is very perishable. The speed of development of field husbandry is great, of animal husbandry slow.

The Needs of the Native Agriculturist: These may best be revealed by describing what he lacks.

The seed of the crops he grows is lacking in vitality, it is impure in that it does not breed true and it is generally a mixture. He is addicted to the growing of crops like grasses producing a starchy small seed resembling bird seed. He lacks a variety of crops of some sustaining power; there are many food crops but he balances his ration rather badly.

He lacks the fundamental knowledge of how to prepare land, his agricultural work generally being very slipshod. The European is wrongly accused of having become possessed of the best land in Kenya. He knows how to use land in comparison with the native who possesses as good or even better land in many parts yet fails to secure the acre yields the European can grow, and it is this difference in the use of land which has blinded observers.

The native lacks a sufficiently great incentive for him to amend his methods and to produce a large surplus. Wants being few and the varied produce of the land so bounteous together with the ever open door of work outside the reserves makes him but a casual producer, lacking in energy.

The native agriculturist then appears to need training, to need new seed, to be encouraged in the production of pure marketable types of produce, and perhaps to undertake a definite minimum of cultivation each year. The white man's burden in Africa appears to be to supply the driving force through sheer personality, through legal action and perhaps by economic manipulation.

What does the Pastoralist Lack? He lacks water supplies, new blood in his stock, in himself the just commercial appraisement of his livestock, the desire to possess anything save livestock and women; in other words, generally, he wishes to be left alone, to increase his herds, to do as he pleases and wander if he wills it.

He is seeking for his cattle immunity against disease, asking for inoculations, but in the main, the costs of these inoculations and such taxation as he may be called upon to pay, together with his small needs, are easily met from the sale of perhaps one animal and several skins or hides each year.

As an instance of the rapidity with which tribes can accumulate livestock, the following is an example: The Samburu tribe, weak in numbers, to-day but 10,000 of all ages, fifteen to twenty years ago, were sheep and goat owning people who lived mainly in sheep country. On account of the presence of disease in their sheep and in the absence of their more acquisitive and warlike neighbours, the Masai, who had moved southwards, by a process of barter and subsequently by breeding, this tribe, formerly the owners of practically no cattle, in the space of under twenty years, is to-day the possessor of quite 120,000 head of low-value cattle in addition to over 150,000 head of small stock. With this as an illustration consider the insatiable capacity of many other native tribes, as an illustration, the Wakamba, who by increasing their herds have also peacefully occupied land outside their reserve. The difficulty would vanish were the cattle marketable and of a value beyond a local one. It is obvious, therefore, that when we endeavour to limit disease by inoculation we must at the same time increase the carrying capacity of the reserves, limit the numbers of cattle to a figure safe for an under average year, see to it that female stock is not crowded by the less useful oxen, queens and surplus bulls, and equally important we must educate the native to appreciate commercial quality in cattle.

How, as a country, and as controllers, trustees, or whatever you will, are we to meet the needs? It should be realised that what we term "needs" may be no such thing in the native estimation. Natives as a rule have few needs and they are quite able to meet most of their needs without much assistance. They are, however, increasingly desiring education and medical attention. What the native has are wonderfully valuable assets if used and developed. From an Imperial point of view it savours of foolishness to allow these assets to be misused, to allow them to depreciate, and to ignore their value in the scheme of things. But it would also be equally foolish to attempt development in advance of the capacity of the people. Although nominally wards, native tribes are given a considerable measure of what has been termed self-Government, and in their tenacity over such matters as land, wages, labour and leisure, rival if not surpass the strivings of groups of people in European countries. Much sympathy and a considerable amount of anxiety is shown for native tribes and native workers by people elsewhere who are relatively

immeasurably poorer in this world's goods and much more likely to starve and to suffer than the native of Africa. Without very much use of the method of peaceful picketing and without any elaborate organisation natives in the sphere of labour are able to make their demands known and to have their requirements met. And by this same power they are able to resist passively any innovation which is premature.

All this makes it a difficult matter to register progress if it is not welcomed by the native, so that those who would ameliorate the condition of the native have to proceed gently and warily lest they should offend to the extent of rendering ineffective any movement they wish to foster.

We therefore have to take a median line, we have to give the native a return step by step for every effort he makes. The chiefest demand is for education and for medical facilities, the root requirement is food varied and plenty of it. As individuals their every day life outside a reserve is an education, but in many instances it makes no impression and general observation leads one to the conclusion that only a small proportion of native peoples are capable of being fully taught. Whether the proportion will show an increase in subsequent generations is a matter for conjecture. It may be said that the main mass of natives in reserves requires mass treatment and mass control primarily. We therefore may proceed with our plans for the improvement of their possessions recollecting that we are dealing with a people, the individuals of which are very much alike. General instructions then, aiming at betterment in one, two or three directions are a possible means, and have been, and should be applied in the future.

There is a good case for education through the medium of schools. Sufficient evidence and experience has been gained to lead the department to incline towards education of the young rather than to spend a greater effort in the guiding of older people. One would prefer to say nothing about the disappointments with the old people under the system of suggestion, they will try to obey an order but will merely smile at a suggestion, unless of course it suits them.

Particularly is this the case on the Coast where it is important that the young people should be fashioned into something much better than their parents. Young natives at school, at least at an agricultural school, are under discipline: they are drilled daily, they perform all the manual operations in connection with gardens ploughing, the experimental work; in other words they are taught to be good farm labourers. Many tasks that are considered only fit for women to perform are carried out by them. In addition they are taught the subject together with the three R's. The improvement in the boys, their bearing, general alertness, and value as labourers is manifest. A small percentage are really good all round men who should train on to become teachers themselves.

We know that our trained boys are much more useful at work requiring a little skill than the boy who is merely an ordinary labourer. We do want to get out of the system which makes a boy an ordinary farm hand, a pruner, a driver, in other words we wish to train boys to be alert and useful in many lines of farm work. The old tendency of the native, derived from the Indian labourers, of professing one line of work only, be it cleaning boots, cutting grass, chopping wood,

must be broken off and a more useful attitude engendered. The curriculum we have adopted in training at our large farm schools includes both general and agricultural subjects treated in an elementary way. These are Agricultural Botany, Agricultural Zoology, Plant husbandry, Animal husbandry, Dairying, Poultry, Horticulture, Elementary Veterinary Science, Elementary Forestry, English, Swahili, Arithmetic, Geography, and Hygiene. All teaching is done in Swahili. Each pupil has his own school garden and all implements used on the farm are of a type suitable for native use.

The Needs of the Colony: The country undoubtedly lends itself to Agriculture, and, to-day, the production of edible crops is carried on on a large scale. The spectre of famine ought to have been banished by now and the population should increase with the reduction in the loss of lives from preventable causes. The weakness of the position in some native areas is that should there be any shortage of foodstuffs, it is the women and children who suffer, as the men may go out for work and be fed at any time. It is our endeavour to overcome this difficulty by increasing food production in all agricultural reserves. The variety of the dietary should be improved and with increase in wealth the consumption of meat will become greater.

The Colony requires that its fertile areas should all produce a surplus for sale in order that development be paid for and continued. We need to see that effort is not wasted. The amount of energy wasted in native areas is very great. In one instance the laborious and poor construction of diversion weirs upon which one population mainly depends for its existence, is unsound and wasteful. One well directed and well designed effort would free people for more valuable work in their area or outside it. The growing of mixed and poor value crops is a waste which may be eliminated slowly by concerted action in specific areas. The idle standing of oxen, whilst by human power land is dug, for the production of the nourishment of a tribe, is a serious waste. There would be a greater leisure in reserves if many of the laborious operations such as ploughing, and grinding, were carried out by mechanical aid. There is a colossal waste of time in the marketing of produce on the heads of porters, women mainly, transport within reserves is rapidly being augmented, and more collecting centres served by railways or good roads are needed.

The commercial uselessness of the cattle of natives indicates in what manner the time of people could be saved, and finally the ingrained laziness of many natives might be found to be due to the onset of debilitating disease as much as to a natural detestation of work.

The necessity for them being so evident, how are we to effect the desired changes? These will be achieved mainly through the following:—

A. With crops:

(1) The use of better and labour saving implements.
(2) The control of pests and diseases where feasible.
(3) The issue and planting of better seed, distributed from seed farms, as mass issues, after the value of the better seed has been demonstrated in location plots.
(4) By the co-operation of buyers where discrimination against the poorer and preference for the better qualities of produce is shewn.

(5) The general demonstration of better methods, and rotations.

(6) The training of numbers of boys and, if necessary, women, in elementary agriculture.

B. With stock:

The present system of semi-nomadic living is not conducive to livestock improvement, but the feasibility of mass improvements may be given consideration:

(a) *Cattle:* The ownership of the cattle of a tribe is naturally divided amongst families, if the tribe owned the cattle irrespective of persons the application of methods of improvement would be a simple matter. To begin with owners would have to agree to the examination of all their stock and the branding of culls. Arrangements for the disposal of culls within a reasonable period would need to be made, or a tract of country might be set aside for the reception of the surplus oxen, poor females, queens, and surplus poor bulls. There would arise grave administrative difficulties, but by means of Native Councils a commencement may be made. It would be wise to commence with voluntary culling in one group of cattle owners whilst applying the order for a reduction in the numbers of oxen, and the prohibition of the use of non-certified bulls. As stated, native ideals in cattle-conformation are not commercial ideals as yet.

The disposal of the culls and surplus livestock has ever been a difficulty, particularly as the animals are so poor and of such low real value. No great loss would be made were the animals slaughtered for their hides and bones. There are other ways in which cattle could be improved (see the mass improvement of poultry below), but a general and steady improvement of the mass would result from the steady culling under instruction. It would also be important that some natives be trained in the recognition of better types of stock and of the conformation of superior types of native cattle.

With the improvement in livestock should go hand in hand the improvement of pastoral conditions, particularly water supplies. In the matter of disease control the Colony is accumulating experience of great value, but it is a pity that expensive inoculations have to be done for some animals hardly worth the saving. It requires no great strength of imagination to visualise the enormous amount of work, organisation and tactfulness which would have to be exercised were the matter of mass improvement carried out.

(b) *Sheep:* The Masai sheep of Kenya has been the foundation of a number of grade Merino flocks. Other native tribes, namely the Basuto, have managed to breed wooled sheep. The size and quality of Masai sheep could be improved by selection and the use of better rams. The betterment of pastoral conditions too would greatly help.

(c) *Poultry:* As an inexpensive demonstration of the possibilities of mass improvement the Department made a number of issues of pure-bred Rhode Island Red cockerels in limited areas from whence all " native " cockerels had been removed. The results were good and quite up to expectations. It would be possible through the medium of Native Agricultural Societies and Native Councils to work over reserves location by location to effect a large permanent improvement in native poultry.

The guiding principles in livestock improvement are:—

(1) Raise the average standard by culling.

(2) Remove all inferior males.

(3) Remove at the earliest moment many oxen, all non-breeding females, etc.

(4) Raise the carrying capacity of country by providing additional water supplies and enable the land to carry larger types by reducing the distance stock have to move for water.

(5) Establish herds of superior native types in native areas from which later one might issue improved strains.

(6) Make routine the various protective Veterinary operations.

The first movement would naturally be the imposition of a Stock Tax, the proceeds being devoted to the general improvement of livestock, conditions of reserve and Veterinary action. Livestock work in Kenya will be a heavy task just as is the reconditioning of a reserve ruined by the over-accumulation of stock on a restricted area, but if the native livestock of Kenya is ever to become a real asset some action must be taken.

For the development of services and European agriculture the Colony needs nearly half a million workers, for proper cultivation the native reserves need a population about three times as great as is living there at present. Enormously valuable agricultural areas in native reserves are hardly populated and if populated are treated pastorally. The development of this Colony requires that the European shall give of his technical knowledge, his ability to direct, to economise and to demonstrate the use of all the adjuncts of civilisation, it demands that the native people wax strong, that they become agriculturists and that the whole agricultural area of the Colony be developed and utilised. The way in which it is believed this will be achieved is education in work through the force of example, the engendering of " needs " in native peoples, the demonetisation of cattle, and the emancipation of women.

Organisation of Native Work: Believing that much may be saved by the enforcement of simple rules in farming just as on large estates and ranches a manager directs the use of areas, the varieties of crops, the periods of harvest and so forth, power has been sought through the medium of a simple Bill to enable the assets of the country to be preserved and the quality of production to be improved.

One cannot do better than quote the preamble to a short Bill designed for the purpose, which was recently passed by the Legislative Council in this Colony:—

> " This Bill confers powers upon Government actively to improve the standards of production in the Colony and to forbid the growth of crops or plants which are known to be deleterious or in other ways undesirable, also to preserve permanent food crops from destruction.
>
> " Through it cultural methods calculated to increase production could be laid down and in order to prevent immature produce in bad condition being exposed for sale the time of marketing any particular kind of produce may be specified.

"The stocking of land beyond its carrying capacity with resultant poverty and deaths of stock may be prevented and the number, etc., of livestock which may be kept on a given area can be defined. Generally also provision is made for determining the manner in which livestock improvement should be carried out."

It is readily seen that to apply any orders in a native area presupposes the existence of an organisation to see that orders are carried out and also an organisation which is able to advise the kind of and in what direction orders should be applied.

It therefore means that the administrative staffs in native areas should include agricultural officers of experience capable of advising. The Department is endeavouring to establish agricultural schools in all large native reserves and the technical staffs of these schools supervise native instruction and demonstration plots in various locations in addition to their work on the seed farms and schools. The staff provided should be capable of advising the Senior or District Commissioner as to what should be done simply to effect some improvement generally applicable and generally needed.

The Agricultural Officer will require a native intelligence organisation provided by native instructors in each location in charge of the demonstration plots mentioned heretofore. Therefore the educational and advisory work will go hand in hand and the small organisation should be capable of functioning in the beginning.

As experience is gained, and we have some experience of the evasion by natives of orders issued in connection with the cotton crop, we shall need to devise means to ensure that orders are promptly and thoroughly carried out. The character and calibre of the officer delivering the order should be good enough to ensure the obedience of the people.

Firstly, a whole-hearted interest must be taken in the prosperity of their native charges by administrative officers, not merely to protect their possessions inviolate and to uphold native rights, but also to see that all the daily wastefulness of life in native reserves is reduced by rendering the labour of people in reserves more valuable to the country. Therefore the fullest support of the administrative officer in matters of management must be forthcoming, and the joint work of the agricultural officer and the administrative officer reflect itself in the increased prosperity of the district. In Kenya the Agricultural Officer, apart from his educational work, is advisory to the administrative officer. The administrative staff is already fully occupied in various ways and although strongly desiring it naturally feels that agricultural work is an additional burden. In other countries a different system is in operation.

Briefly, the organisation we have to-day is as follows:

(1) Under central direction provincial training and seed farms are being established. The European officers in charge act also as advisers to the Administration, and supervisors of the native instructors in locations.

(2) Attached to the Institution are trained native instructors in charge of demonstration plots shewing improved cultivation, a model rotation, the value of good seed, new implements. These instructors are visited regularly, the condition and extent of crops, incidence of drought and disease is noted for administrative information.

(3) The best pupils from the Provincial training farms to proceed, if desirous, to a higher training establishment at the Laboratories near Nairobi, to supply the demand for teachers and instructors.

(4) European Supervisors to organise Agricultural Societies in reserves, assist in the annual district shows, to make the customs, crops, and general agricultural welfare of the inhabitants of his Province his sole interest. At the same time to see to the introduction of more useful food crops and crops of economic importance.

Mr. SIMPSON said that the paper was very interesting; the advice given was very good, but its application must be slow. The development of the native must be gradual, and his evolution from the savage state could not be too rapid. It must be remembered that, intimately connected with his social life were the factors of women and cattle. The connection between these two made the development of the native livestock industry difficult. The buying of wives was not as direct as the words imply. There was very much more in the question. When a woman left one section of the community, her place had to be taken by a substitute, namely, cattle, to maintain the strength of that community. The religious ceremonies connected with the receipt of the cattle showed that the transaction was not solely purchase. A great deal of study of this and other customs was essential before native agriculture could reach the standard that had been suggested in the paper.

With regard to the development of native schools of agriculture, the Baganda had been educated very largely by the missionary societies, and, naturally, the education had been clerical. The Government had taken up the matter of native education, and considered that it was not a third-class European but a first-class African that should be produced. Agricultural education must play a great part in that development. All schools now had an agricultural bias; agriculture was a subject of primary importance and to promote the teaching all schools had gardens. Help was given by all the scientific and technical members of the Department of Agriculture. On the Government Farm at Serere, 54 students were taken and they were in residence from 1st April to 31st January. They had to take part in all farm operations, received a simple lecture weekly, and were taught the care of livestock. Best value from education could be obtained by explaining the things of every day life that surrounded them, rather than subjects of no immediate interest to native life and conditions.

Mr. KIRBY observed that in Tanganyika the problem was unlike that in Kenya. There were no native reserves, and the natives could move from place to place with perfect freedom. As an example, two of the more intelligent tribes, the Wanyamwezi and the Wasukuma, had often wandered far from their original home and had formed many agricultural settlements, which, incidentally, might serve as sources of labour.

Instruction in regard to native agriculture involved co-operation between the education and agricultural departments. There was at present some concentration of teaching at central schools; and, later, native teachers would be trained, who would go out to teach agriculture in the schools, with the assistance of school gardens. It was felt that the latter system would more rapidly spread agricultural education

among Africans than a system merely of central schools at which agriculture was taught. He believed that the cost of training in that way was cheaper than in agricultural schools. Incidentally, instructors were produced who went out amongst the people and taught them. The work of the teachers was inspected by agricultural officers, assisting the Education Department.

Mr. WORTLEY said that very little had been done to introduce agricultural education into Nyasaland. Up to the present, the education had been purely in the hands of the missions, with the aid of a small subsidy from the Government. A Director of Education had recently been appointed, and he felt that a strong Agricultural bias would soon be given to native education.

THE CHAIRMAN (Mr. Holm) stated that very soon after his arrival in Kenya he came to the conclusion that, in order to promote native agriculture, the training of Africans in agriculture was fundamental to the progress of the work. He considered that a mass effort of the kind required could not be carried out satisfactorily unless there was behind it a considerable number of trained African instructors; it was for this reason that the Kenya Government had started native agricultural schools, such as they were. They were presented with the difficulty that they could not secure as pupils boys who had had an elementary education, and they were forced to start by giving the pupils a certain amount of elementary education. At the same time those pupils had the whole of the work of the institution to perform. They saw how different crops should be cultivated and managed and harvested, and, finally, disposed of. The primary object of these agricultural schools was to supply, in the course of time, the Agricultural Department with a number of qualified agricultural instructors; at the same time, it was intended also to turn out Africans who would be competent to teach agriculture in a suitable elementary manner in the native village schools and to take charge of the school gardens attached thereto. Experience elsewhere had proved that the effort would be a failure if somebody, who was not an agriculturist, attempted to teach agriculture. In Kenya, they had further in their minds, in connection with the general scheme of organisation, that the native agricultural schools situated in the native reserves (of which they hoped to have three) would supply a central school at the Scott Agricultural Laboratory with the most promising pupils, to whom would be given an additional training in agriculture and elementary agricultural science. From those pupils they hoped to get for the Department a staff of competent agricultural instructors. The effort, he thought, had so far been successful; and, though not fully trained, they had in the Colony about forty instructors who had already passed through their schools and had attained a fair degree of efficiency. Part of the organisation was that the instructors should be located at centres in charge of demonstration plots on shambas which would serve as useful object lessons to the neighbouring native cultivators.

Mr. VAN DEN ABEELE said that in the last few years the Belgian Congo Agricultural Department had made a very great effort in regard to native agricultural education. In the different Government plantations experiments were carried out in connection with coffee, cocoa, oil palm, rubber, and cotton growing; and a great number of native teachers were trained in a most practical way in the best methods of cultivation. After one or two years, these teachers

were sent back to their native villages to work as real agriculturists under Government control. Various agricultural schools existed in the country, and in some parts agricultural shows were organised.

In every district agricultural officers in charge included native instruction in their programme of work; under their advice and control native model gardens were made, oxen were trained, mechanical culture taught, selected seed distributed, adequate rotation of crops planted, and encouragement given for the distribution of interesting varieties of various food crops.

It might be said that some natives already quite realised the advantages of more advanced agricultural methods, and in some parts of the Congo (Uele, Maniema, Sankuru, etc.) a fair amount of export produce was already grown. In addition, it must be understood that economical conditions in a colony like the Belgian Congo were quite different from those in other countries of East Africa, where mining industries did not exist. In the Belgian Congo those industries (gold, copper, diamonds, etc.) required a great amount of labour, and the Agricultural Department in the Belgian Congo aimed, in the first place, at producing food for these mining labourers. Produce for export was, nevertheless, becoming very important, especially in respect of cotton.

Mr. KIRBY referred to the Kilimanjaro Native Planters' Coffee Association, a society that had made considerable progress. The natives concerned were the Wachagga, who were a progressive agricultural tribe. The Society, as far as possible, managed its own affairs with the sympathetic assistance of the Department of Agriculture and the Administration. There was a small fee for membership. The Society had drawn up rules, and its chief object was to form a public opinion among natives which would foster good coffee production and preparation. It also graded and exported the coffee of its members for sale in London. The Society had no legal powers; it would, however, be able to report cases where preparation or cultivation were unsatisfactory, and legal action would then be taken, if required, by the Department of Agriculture. The Society was young, but popular, and it was, as far as could be seen at present, likely to do very useful work. That was, so far, the only kind of native agricultural co-operation which existed in Tanganyika Territory.

Mr. WORTLEY thought it very desirable that a resolution should be passed urging on the various Governments that as far as possible, education in the different territories should be given a strong agricultural bias.

Mr. MILLIGAN said that the subject of agricultural education was brought up before the Agricultural Department in India about 20 years ago: it was rather pressed upon the Department because the educated community in India were themselves anxious to see the peasantry placed on a satisfactory footing. The Agricultural Department, wisely, he thought, had been very chary of approaching the subject and had practically refused to touch it until they had had some experience of the country. They found that there was no real demand on the part of the agricultural poulation for education generally. It was feared by the peasantry that their sons if educated would leave the land and join the clerk class in the town. The best thing appeared to be to gain the confidence of the agriculturists themselves in the first place and create a demand for agricultural

education, rather than to force an agricultural education upon them. The best way to gain their confidence was obviously to produce something of practical usefulness. This was difficult because of their small holdings and because of their intimate knowledge of agricultural practice. The most useful thing was to introduce improved strains of crops. They found the native seeds very mixed. By analysis, purification and subsequent distribution they had established their prestige amongst the natives. Even then, it was found that the demand for agricultural education was practically nil. He did not know how matters would eventuate in India, but a few experimental schools had been established. Further progress would depend on the success or otherwise of the experiment. He thought that East Africa was on a different footing and that if a genuine demand for agricultural education by the natives themselves could be created, it was almost certain to succeed.

Mr. KIRKHAM supported Mr. Milligan's views and in so doing referred to the education of Arabs and Swahilis in Zanizbar. He said that the Africans of Zanzibar had been much longer in contact with civilisation than any natives of the East African Territories and that they found that the African was precisely like the Indian in that he wants immediately to become a clerk. While he was very much in favour of improving native agriculture, he thought the term "Agricultural Education" was rather dangerous, because it meant giving a little knowledge of agriculture under a lot of distracting education which took the native away from his agricultural pursuits. He was perfectly sure that they would, after receiving this education, refuse to soil their hands with anything other than ink. He thought it was better to have civilisation before education. To start "educating" savages would do no good.

THE CHAIRMAN (Mr. Holm) said that he was sure that they all appreciated very much the views that Mr. Milligan had given them. He would, however, like to emphasise the point so far as the educational effort in Kenya was concerned. He had indicated that the effort of the Department was mainly directed to the training of native agricultural instructors and not to the training of a large number of Africans who were simply going back to the Reserves. The teaching of Agriculture in the village schools was the concern of the Education Department. It was felt very strongly that, among an agricultural people, it was right and proper that some agricultural instruction should be given in the native village schools. He was glad to be able to say that an effort for the improvement of native agriculture in Kenya was being made. They were issuing in bulk quantities improved seed of different kinds and in several directions progress was being made, but in a new service of that kind experience had to be gained.

On the Chairman's suggestion, a Committee, consisting of Messrs. Wortley, Kirby, Simpson, and the Chairman (Mr. Holm) was appointed to draft a conclusion.

The following conclusion was submitted by the Committee and unanimously adopted:—

(a) It is desired to impress upon the Governments of East Africa the great importance of a pronounced agricultural bias being given to the education of Africans in these territories, where

agriculture is almost the sole industry upon which the sustenance and advancement of the African peoples depend—a principle which has already been emphasized by the Phelps-Stokes Commission;

(b) It is further considered that, for the development of native agriculture, a staff of Africans trained in agriculture and capable of performing the duties of agricultural instructors is essential; and it is urged that the necessary provision should also be made for the systematic training of African teachers in agriculture for schools in native areas.

MUTUAL SUPPORT AND ECONOMIC BALANCE BETWEEN NATIVES PRODUCING FOR EXTERNAL, AND THOSE PRODUCING FOR INTERNAL, CONSUMPTION.

Mr. KIRBY made the following statement:—

By production for external consumption is meant production for export.

Partly because of the liability to dearth, more or less extensive in any one season in Tanganyika Territory, the tendency has been to encourage every native grower to produce food crops in addition to any purely economic (export) crop such as cotton.

The world's development has shown that this method of "every man his own provider" is uneconomic, especially in that (1) those who possess no economic (export) crop yielding a comparatively large monetary return per acre, such as cotton, possess in times of shortage little or no money for buying food; and in that (2) it limits the circulation of money, that economic necessity for general prosperity, in the country itself.

There are signs already in East Africa (Tanganyika and Uganda particularly) of the development of the African producer who grows cotton as a main crop, others being subsidiary, chiefly for rotation.

It does not appear wise that this type of producer should be discouraged.

With improved transport facilities districts whose distance limits their production for export (such as Kigoma, Ufipa, Rungwe, Songea in Tanganyika), or which are unsuited to cotton (Dodoma in Tanganyika) are likely to become producers of food for (among others such as plantation labourers) natives concentrating more particularly on cotton growing. These natives will extend the market for the food-crops of the former, of no value for export; and those will become indirectly producers of cotton, as their activities will enable the native cotton grower to use land for it that he would otherwise cultivate for foodstuffs.

Development in this direction, so that natives in the more remote districts may help indirectly the exports (of both native and non-native origin) of a country to figure increasingly in the trade of the world, is regarded as natural and important for encouragement.

(The above was circulated in the form of a note under T.C.(C)Ag.12.)

Mr. KIRKHAM said that about three years ago he was touring in Java and was very much struck by the care of the Dutch Administration for the 40,000,000 natives living on that island. With such a vast population and such a climate, foreign capital had come in with a view to making rich profits—as had been done—out of sugar. In general, as was done in East Africa, factories were put up, of which there were some 300 on the island, and sugar cane was bought from the native growers. This industry increased so much that Government realised that something had to be done to prevent the natives becoming too dependent on foreign capital and they laid it down that natives might only enter into contracts for the supply of sugar cane for a period of one year, and then conditionally that they planted the same land with rice next year, thus preventing the sugar industry from swamping the food production of the country. He thought that was a wise step on the part of the Dutch Administration.

Mr. SIMPSON thought the problem was largely one of cost of transport. It was a very difficult problem in a centre like Kampala nowadays for a native to get his food cheaply, but, from the point of view of Africa, Kampala was a very large place and supported a large number of natives from outside. The natives in the Province lived on plantains and it was evident that it was not economic to transport plantains long distances. In places with crops like tea and coffee, there was a tendency to concentrate on the money crop and neglect food crops, but with a crop like cotton, as they had to organise the industry in Uganda, it was possible, in fact compulsory, that for every acre under cotton, there should be a larger acreage under food crops. In territories which were very sparsely provided with railway communications, it was very difficult indeed for food producers in outlying areas to supply their food products at a reasonable cost to natives who were growing crops for export; in fact, it was often cheaper for the latter to buy imported food. In Uganda the natives from outlying areas came in to work on public works and railways more particularly, and the internal costs of transport were too high to admit of the transport of food products at any price which the natives could afford, so that instead of becoming food producers, they became the labouring force of the Protectrate for the time being.

Mr. KIRBY drew attention in that connection to crops such as rice and beans. Rice and certain kinds of beans would stand a certain amount of porterage. In a certain area in Tanganyika last year 10,000 tons of rice were taken 120 miles by head porterage to the railway: rice produced by the efforts of native producers, assisted by the buying power of the Indian shop-keeper. In that case the natives were able to grow cotton as a principal crop and could be fed on plantations through the production of more remote districts. He had in mind not only that the Coast natives should be fed from remote districts, but also that the remote districts should increase their production of food crops with a view to providing food for those districts which possessed adequate transport facilities and could grow economic crops to advantage.

Mr. SIMPSON said that there was a small rice industry in Uganda, but it was 50 or 60 miles from the port on Lake Victoria; attempts had been made to try to encourage that industry by prohibiting the import of rice from other territories. He had, however, been unable to support the proposal because there was a large rice

production at Mwanza and the transport from Mwanza to Kampala and Jinja was cheap and easy. It would be a handicap to Uganda if they did not get rice from Tanganyika Territory, as their own rice producing areas were too remote. To his mind cheap transport was the solution of the supply of native food crops.

Mr. WORTLEY agreed entirely with Mr. Simpson that the question was one of cheap transport. As conditions were in Nyasaland at present the Agricultural Department felt that it was necessary to keep impressing on natives the importance of producing adequate supplies of food crops for their own use. There was also the question of rotations of crops and it was an advantage to rotate food crops with cotton and tobacco. With regard to the question of transport, it was to-day cheaper to import maize from Southern Rhodesia than to transport it 180 miles within Nyasaland.

THE CHAIRMAN (Mr. Holm) had thought on reading the note that the adoption of the proposal depended on two things: one was comparatively cheap transport, and the second (a point not yet mentioned) the holding of a reserve of money by those natives indicated by Mr. Kirby, in order that they would be in a position to buy the food crops which they did not grow. He was doubtful whether the natives in the " backwoods " of these territories were yet in a position to have this principle applied to them and he thought that they would have to go through the ordinary stages of evolution as farmers; in other countries where there was a more intelligent community on farms, the farms were made as nearly as possible self-supporting. He thought Mr. Kirby had raised an important question and he hoped that it would be considered by all who were responsible for native agricultural development in East African Territories. He thought that the principle should be applied, where possible, but he did not think that it could be applied for some considerable time, nor did he think that they would be wise to attempt it at present.

Mr. KIRBY agreed that it was a matter of evolution. He had in mind not only plantation labourers but ordinary natives, who could be fed with the assistance of more remote districts, if, as Mr. Simpson suggested, they had reasonable transport. They had another example: Bordering on Lake Tanganyika in the remote district of Kigoma their efforts were directed to the production of millet, beans and rice which were transported by rail to the more sophisticated natives, and, more especially, to the natives employed on plantations and Government work, so that the latter had now an opportunity of getting food from an origin which did not exist in the past.

In reply to the Chairman, Mr. Kirby stated that the note had been written to obtain information and to ventilate the matter, as they had felt that in the predominant interest of production of economic crops the production of food for export from district to district had been rather forgotten.

Mr. SIMPSON said he had always felt that it was a great mistake that a bale of cotton or a bag of maize should be produced for export by natives in East Africa, if the natives of the area were not properly fed. It was impossible to have a contented people, capable of doing a day's work, unless they were properly fed and the first duty of the Agricultural Department was to ensure that the people were supplied with sufficient food.

Mr. MILLIGAN thought it just possible that although questions such as the circulation of money, etc., were of very great importance to more advanced countries, they might be stressed too far in backward territories such as East Africa. He agreed with Mr. Simpson that the first thing to do was to make the country as self-supporting as possible. It was also probably very important to render communities as far as possible self-supporting in those places where transport was difficult. There was also the question raised, *i.e.*, of the very great importance of alternating, and, as a representative of an export commodity, he could say that the importance of questions of that nature was fully realised. If it was considered advisable, he thought the Conference might usefully draw attention to the dangers of over development of export crops in districts where communications were bad and also to the general question of the uneconomic principle involved in a territory growing a crop for export and paying a very high charge for the importing of a food crop which it might very well grow itself. He did not know, however, if any advantage would be gained in emphasising these points.

Mr. SIMPSON hoped that Mr. Milligan would not press the point. He had tried to make the point that people in East African Territories had to be properly fed. Where they had a crop like cotton, the larger the acreage under cotton the greater the food supply, and, in Uganda they had communal food granaries which were filled with food every year at the harvest time. In some parts of Uganda they were liable to drought every seven or eight years and one-third of fresh food every year was put into the granaries, so that whatever happened the people had sufficient food. He thought it would be a great mistake to make any resolution, because one of the primary duties of an Agricultural Department was to produce food for the people of its own country.

Mr. WORTLEY was sorry if anything that he had said should have misled Mr. Milligan. He thought the point raised by Mr. Kirby was bound to become more and more prominent as time went on, but for the present it was desirable for Governments to induce natives to produce their own food rather than to depend on purchasing it with money acquired by the sale of export crops.

Mr. KIRBY welcomed Mr. Milligan's remarks, because there seemed to be an idea among certain people at home who were interested in the production of cotton that the one aim of Agricultural Departments in East Africa should be to produce cotton, and that the value of a department depended upon its ability to make natives grow cotton. He was sure that they could depend on those present who were principally concerned with technical cotton work to impress on people at home that food production was paramount, and that cotton growing came (possibly) next.

Mr. KIRKHAM stated, as representing Zanzibar, that 50% of the total area of the Island was under cultivation and that the rest was very large coral rock. Their crop was a great export crop and they imported their food. Their transport difficulty was not great and food was landed at their door-step. He said that each Director of Agriculture knew the requirements of his own territory and could advise his Government upon the development of the country accordingly.

In reply to the Chairman, Mr. Kirby stated that he was satisfied with the discussion and grateful for the information that it had evoked.

THE USE OF EXTENDED NATIVE ADMINISTRATION FOR AGRICULTURAL PROGRESS.

Mr. KIRBY read the following paper (referred to in the Agenda as T.C.(C)Ag.13):—

The giving of greater responsibility and powers to native administrations, under advice, has two important results: the formation of centres of main activity (native court sites) distributed usefully throughout each district, and the possession of funds by the native administration which are directly available for the benefit of those for which the administration works.

The position of agriculture as the sole native industry brings it about that the best use of those funds for all is to assist in the increase and improvement of husbandry (sometimes including ploughing) and of the plants used in husbandry. (Other non-agricultural matters, such as the similar provision of secondary roads, native court buildings, dispensaries, are not for consideration here.)

This means that each district community provides for its own intimate needs; whilst all share in the necessary territorial provision under the Estimates for supplying general (including agricultural) administration, the general fostering and protection of agricultural industries, and the means of transport (roads and railways) for which Government is usually responsible in the tropics.

Government Estimates of Expenditure thus become territorial in extent and application; and items (often of pitiable magnitude) intended for direct, localised assistance can be considered for removal from them. At the same time the " domestic " funds of each district community can be expended in intimate relationship to its needs, under the direction of Central Departments which will prevent wild expenditure lacking fitness in regard to the conditions of the area and therefore uneconomic.

The agricultural phase of the matter can now be considered in more detail. An obvious use of Native Court centres is as stations where agricultural activity for the surrounding areas begins and radiates. The first stage at these is the growing of crops in the correct ways in plots belonging to chiefs or the more influential natives, in co-operation between them and the Agricultural Department, such plots being used also for crops or strains or varieties of crops whose success in the area is still uncertain; and parallel work is carried out in the school gardens.. Arising from these plots, or organized side-by-side with them, are seed-farms used for obtaining quickly increased supplies of seed of crops of proved value, for distribution under careful control and record; and here again the school garden will be usefully employed, provided that care is taken that its area is not extended, for this or any other purpose, to a degree that entails drugery to its pupils, and instead of helping agriculture makes it unpopular as early as possible. Seed-farms do not serve as a useful means of merely supplying seed on a general scale to natives; for their conduct for this purpose would usually make them disproportionally large and expensive, and their output would be smallest in the most unfavourable seasons, at the very time when, owing to partial failure of their own resources, the demand for seed by natives is greatest.

It is useful here to consider the propriety of the use of native administration funds for providing seed-stores and the seed for them to supply resources in the place of the seed customarily saved by the African farmer for sewing his crop of the coming season. It is considered that the storage and supply of seed in this way is not warranted: it would be costly and cumbersome, and entail to natives journeys for seed that are not now necessary as well as danger of loss through spoiling in store (although, as far as damage from insects is concerned, each store would be designed readily to be converted into a fumigatorium). (The case of cotton seed, distributed from ginnery stores, is obviously particular.) The customary individual provision of seed for general purposes, evolved naturally and long tried, is best; and it can most readily be aided, in times of unfavourable season, by obtaining supplies from the nearest (in point of readiness of transport) more favoured districts through the use of agricultural departmental funds budgeted for the seed improvement dealt with above and in view of the possible occurrence of such catastrophic conditions.

The general conclusion is that the paramount importance of agriculture in native administration caused by its intimate necessity in the life of the native himself makes expenditure on agriculture of the funds belonging to such administration the fairest and most apposite among the means of using them for the benefit of those by whom they are supplied.

Mr. SIMPSON observed that the reader of the paper had referred particularly to Uganda, so he took an early opportunity of explaining the position as it affected Uganda. In regard to the cotton industry their energies were particularly directed to the Eastern Province where the natives were backward, but all the land was Government land, and there were cotton plots at all centres. With regard to funds, some of their native funds were very large; for example in the Eastern Province all native fines went to a fund called the Lukiko fund and there was no difficulty in getting money when wanted. The Lango district was particularly wealthy and an experimental station was supported there from native funds. With regard to famine, they had adopted a system of compelling people in all areas to plant a certain amount of cassava, which can be left in the ground for a considerable time and used if and when wanted. Granaries for food had cost the Government nothing; the natives were merely told to build granaries and to store their food. It was fully realised that Government had to take the initiative, as, although in many districts the natives might have surplus crops, they would not store it, but would make it into beer and drink it and in case of a drought they would have to get food from some considerable distance. The grain stored was a very small millet, called bullo.

In reply to various questions, Mr. Simpson stated that little maize was grown in Uganda and that it was only just being introduced in certain areas.

The granaries were communal and the property of the natives; they varied in shape according to districts and were in some cases merely native nkokwes on stands. At each harvest one-third of the oldest food was removed and replaced by new so that the granaries were kept full. He further stated that they were not free from weevil in Uganda, but that the weevil would not lay its eggs in small grain if it was sufficiently dry. Their small millet was therefore very

suitable for storage. They could not store plantains, and maize would require corrugated iron stores. In regard to cassava they did not insist on the planting of any definite amount but records were kept of the acreage planted in each district.

Mr. CAMERON had seen the system in certain districts in Southern Rhodesia which were liable to famine. He did not think there was any question of compulsion.

Mr. WORTLEY said that he had been urging the importance of this matter on the Nyasaland Government but that they were faced with the difficulty of dealing with maize, which was the chief diet of their natives.

POSSIBILITIES OF CO-OPERATION AMONG NATIVES IN EAST AFRICA.

Mr. KIRBY made the following statement:—

Tribes vary in intelligence and enterprise. It is thought that the benefits of co-operation will appeal to tribes on the higher plane of these qualities. In what directions should it be begun? Wherever the possession and use of capital goods will improve agriculture, it might well begin with the provision of funds to procure these goods. An example is with ploughing. Experience in Tanganyika Territory has shown that the native character is averse to communal agriculture (ploughing, with cultivating, marketing and sharing of proceeds), but not to co-operative ploughing alone. Co-operation, in fact, is the only means available, to the large body of them, of securing ploughs. It is, moreover, the only economical means of using the plough, for, with individual ownership and small fields, the use of the plough will not cover its annual cost in interest and depreciation, and the hiring of ploughs is uneconomical. Co-operative credit has not been attempted and it would be interesting to learn what efforts have been made in other countries with this form of co-operation in particular, and any form in general, among African natives.

(The above was circulated in the form of a note under T.C.(C)Ag.14.)

Mr. SIMPSON said that his experience of the subject had not been very wide and he knew of no experiment having been made on the lines suggested. In Uganda they had tried communal ploughing and in some areas it had been successful. He had been trying to work on another principle, namely the development of an individualistic attitude. In olden days the chiefs had power of life and death over their subjects who were compelled to work for their chief when required. The Uganda Government was trying to make it possible for every man to get the financial benefit of his own work. When that system reached a certain stage, it might be possible to evolve some method of co-partnership among individuals but the individual must feel himself economically free before he could enter into partnership with others.

Mr. MILLIGAN said that with ploughing of course there was the difficulty that every man ought to own his own plough; as a method of introducing the use of implements, however, co-operative purchase might be very useful. In India he had found on several occasions that there were as many as four or five owners of ploughs. This was however due to the fact that they were purchasing ploughs for secondary operations.

Mr. KIRBY stated that when natives had learnt through mutual co-operation that ploughs were useful they would each wish to possess one of their own. An interesting fact was that in the northern districts of Tanganyika, ploughs were being used for harvesting groundnuts. In bringing up the subject he had in mind a system of co-operative credit which had been found very useful in the West Indies based on the Raiffeiran system. He did not know whether anything of that kind had been introduced into the East African territories.

Mr. WORTLEY stated that natives in Nyasaland had not formed co-operative agricultural societies.

THE CHAIRMAN (Mr. Holm) observed that, in order to go as far as Mr. Kirby had indicated, it would be necessary to pass legislation dealing specifically with the activities of co-operative societies, largely for the protection of the members themselves. He thought that those who had been acquainted with co-operative movements must realise the difficulty which had been experienced in practice in managing the societies, many of which had come to grief in the first instance. Personally he would not advise that co-operation along any very extensive lines or involving the expenditure of very considerable sums of money should be encouraged or promoted. Such agreements as they might make among themselves, such as the common use of the plough, might be a useful method of co-operation. Beyond that he did not think that the African was ready for a co-operative movement at present.

TOBACCO GROWING BY NATIVES AND ITS DEVELOPMENT AS AN INDUSTRY.

Mr. SIMPSON stated that in Uganda there were considerable tracts of land suitable for growing tobacco and the natives were increasing their consumption. They were endeavouring to cultivate a suitable plant for local consumption but were not, for the time being, attempting an export trade as that would require a considerable technical staff of Europeans. They thought that it would be a good thing if the natives could be encouraged to learn something about the proper cultivation and growing of tobacco, and he would be glad of advice concerning the experience gained in Nyasaland in this connection.

Mr. WORTLEY stated that there would be some difficulty in answering Mr. Simpson's question if the information were restricted to the growth of tobacco for local consumption. He, therefore thought it preferable to give a short description of the present position in Nyasaland. The native tobacco industry has expanded considerably in recent years.

In 1924, 500 tons were produced by natives.

In 1925, 1,100 tons were produced by natives.

In 1926 over 1,600 tons, and it was estimated that over 2,000 tons would be produced in 1927.

The natives in Nyasaland had a great advantage. Tobacco had been grown for many years by Europeans and many of the natives now engaged in the industry were familiar with tobacco culture owing to the experience gained as labourers on European tobacco estates. In the Central Province the natives had received close supervision

from a European interested in the industry. The very rapid development of this industry was cause for concern for several reasons. Firstly, the reputation of Nyasaland tobacco might be jeopardised, secondly the natives might neglect their food crops, and thirdly, deforestation was rapidly being brought about in order to provide fuel for the curing of tobacco. Theft of European grown tobacco had increased since there had been a ready market for native tobacco, and there was a menace of a shortage of labour for European estates. Government had recently introduced a tobacco Ordinance and, to control the industry, a Tobacco Board had been appointed to assist and supervise the native tobacco industry. The Ordinance provided that no one might buy native grown tobacco without a licence and buyers were restricted to certain premises. All natives who wished to grow tobacco were compelled to register but no charge was made for registration. Active measures were being taken by the Tobacco Board to ensure supervision of growing, harvesting, curing and grading.

Mr. SIMPSON thanked the Nyasaland Director of Agriculture for the information he had given.

Mr. KOCH stated that in the Union of South Africa the natives were not well organised for growing tobacco, they produced large quantities of a rank raw material which did not find its way into the European market. Hottentots and others grew tobacco of fair quality in the Eastern Province. In the Transvaal very little was grown by natives. What was produced in many districts had to be sold through co-operative societies. In the native areas tobacco growing was not under control except where native schools were functioning as in the Transkei.

Continuing, Mr. Koch made the following statement on the production of tobacco in the Union of South Africa:

Until about three decades ago the majority of the tobacco growers in South Africa utilised all their tobacco for roll manufacture on the farms by first subjecting it to a process of fermentation. This so-called Boer tobacco was used for smoking, chewing, and for snuff puroses. At present the term Boer tobacco means the South African Virginian type of leaf grown and manufactured in this country as pipe tobacco. In cigarette tobaccos there are two distinct popular types, that made from purely Virginian leaf (locally grown and a small percentage imported) and that made from South African Turkish leaf in a blended form.

As the aroma, character, and quality of tobacco leaf are almost entirely dependent on the soil and climatic conditions under which it is produced, striking differences in the type of leaf are obtained from the different localities. These localities are the Magaliesberg areas (Rustenburg, Marico, Pretoria, Waterberg, and Krugersdorp districts), the Vaal River areas (Vredefort and Potchefstroom), the Piet Retief and the Barberton areas, the Katriver and Oudtshoorn areas, and the Turkish tobacco area, namely the Western Province.

In the Turkish tobacco areas the crop is grown under natural precipitation which falls in winter with scarcely any rainfall in summer. In the other areas the tobacco crops are raised under conditions depending on summer rains and supplemented by irrigation only when necessary, or grown almost entirely under irrigation.

PRODUCTION:

The production of tobacco in the Union of South Africa was as follows:—

1919	14,182,929 lbs.
1920	11,644,300 lbs.
1921	16,620,640 lbs.
1922	9,813,000 lbs.
1923	9,671,000 lbs.
1924	10,590,263 lbs.
1925 and 1926	(not available yet.)

The average production in the various Provinces for the years 1911 to 1923 was as follows:

Transvaal	6,887,311 lbs.
Cape Province	4,013,483 lbs.
Natal	867,507 lbs.
Orange Free State ...	510,380 lbs.

The amount of Turkish leaf produced in 1924 was 816,009 lbs. The local consumption is estimated at about 12,000,000 to 13,000,000 annually.

CREATING A DEMAND.

The flavour and aroma of Union grown tobacco are peculiar and, as a rule, do not appeal to the consumer who is unaccustomed to them. If this tobacco is placed on the overseas markets in sufficient quantities to develop a taste for it an increased demand would stimulate production. On the other hand, the methods of preparation in the Union are practically unknown to the overseas buyer, and to a large extent the article is not, as yet, put up in such a form as to lend itself readily for selling overseas. It is almost certain that if the demand from British markets were increased the crop would be prepared as suits the demand. Excellent pipe tobaccos and cigarettes are manufactured in the Union for which there is a ready local demand. By the manufacture of South African tobaccos in Great Britain a similar demand can be created over there, and all the more readily if blended to suit the existing taste. Certain defects can be found in our tobacco, but these will be remedied as the industry progresses and the grower understands the requirements of the overseas markets.

The majority of the tobacco growers in the Union are now well organised for the preparation of the crop for market and the sale of their product. With the compulsory Co-operative Act whereby all growers in defined areas are now compelled to sell their tobacco crop through a co-operative society, and whereby greater stability in prices is assured, new life has come to the tobacco growers and a greatly increased acreage under tobacco can confidently be looked forward to. There is undoubtedly a bright future for the tobacco industry in South Africa. Growers are showing their confidence in the future of this industry by increasing their acreages. It is expected that the output for the coming season will be at least 40% greater than that of the previous season.

At present one of the chief needs of South Africa is an extension of trade within the Empire. From this point of view the tobacco industry is particularly rich in the potential advantages which it offers.

The preference of 25% on Empire-grown tobacco is also having a considerable effect in stimulating interest and enthusiasm in the further development on Dominion Soil and in the huge market provided by Great Britain. As it is necessary to establish our product against a deeply rooted predilection for American and Turkish tobaccos and of competing with foreign producers enjoying highly protected home markets in almost every case, it was obvious that a definite recognition of preference in the British market, was absolutely necessary for progress.

Mr. WORTLEY stated that, in Nyasaland, native grown tobacco was sold to Europeans who graded and prepared it for export. It must not be forgotten that tobacco growing and curing was a highly specialised branch of agriculture and that the markets would soon be ruined if the unsaleable tobacco brought in by natives was not rejected by experienced buyers.

WHEAT CULTIVATION BY NATIVES.

In reply to a question by the Chairman, Mr. Vanden Abeele stated that what his Government wished to know was whether the cultivation of wheat by natives was carried on under Government control.

Mr. BOOTH stated that the native cultivation of wheat was first started in Kisii country, where a fairly good and rust resistant type was grown, but it had little commercial value. At a later date the Department of Agriculture introduced their own seed but the principal difficulty was the transport problem. Plantations had been made in the North and Central Kavirondo districts, but there it was found that the altitude was generally too low, except in the area near the new Uganda line. The natives did not at first take to it very well. The experiments on the Bukura Experimental Farm were not successful. It was found that the plant flowered when only 1½ feet in height. The native grown wheat had proved of great value as food to the natives.

Mr. KIRBY stated that in the Rungwe District of the Tanganyika Territory wheat growing was an important product to certain tribes at elevations over 5,000 feet, where they grew practically nothing but wheat and sweet potatoes. There were complaints about rust, but it was found that it was due more to climatic conditions than to anything else, appearing in one year under bad conditions and disappearing the year following. The natives had grown wheat for several years, but there was no export trade, owing to the cost of transport.

Mr. SIMPSON stated that in Uganda in areas where wheat could be grown, the local demand for wheat was small. Owing to the heavy charges for transport, the large centres of population in Uganda could import their wheat supplies much more cheaply than local supplies could be obtained. He thought that such industries could only be built up gradually, as transport facilities increased, but there was no doubt that wheat was a crop well suited for native cultivation in certain areas. The Conference agreed to the following resolution:

> That wheat growing by natives should be encouraged in areas suitable to the crop, not only for improving the food ration for the native population, but also for production for purposes of sale where satisfactory transport conditions exist.

CHAPTER VII.—CEREALS.*

SOME ASPECTS OF CEREAL GROWING IN KENYA COLONY.

Mr. BURTON read the following paper (referred to in the Agenda as T.C.(C)Ag.6):—

The Highlands of Kenya Colony, though they lie about the Equator, possess a climate which varies from sub-tropical to temperate. This is on account of their altitude, which ranges from 4,500 feet to 10,000 feet. The soil is, on the whole, rich and consists chiefly of a lightish loam interspersed with patches of heavier soil. The rainfall is usually adequate, the temperature warm in the day time and cool at night, growing conditions being good. Apart from purely stock raising areas, the highlands can be divided climatically into four different groups according to altitude and rainfall.

GROUP No. 1.—Altitudes of above 7,000 feet and rising to 10,000 feet and with a prolonged rainfall such as the Solai and Mau Escarpments, and the Timboroa district.

GROUP No. 2.—Altitudes of about 7,000 feet and with a prolonged rainfall such as Njoro.

GROUP No. 3.—Altitudes of under 7,000 feet with a prolonged rainfall, such as the Trans-Nzoia, Uasin Gishu Plateau, Nakuru, and Solai areas.

GROUP No. 4.—Altitudes of under 7,000 feet, with two short rainy seasons, such as Nairobi, Thika, West Kenia, and Machakos districts.

The introductory remarks indicate that a wide range of crops can be grown. Some of these crops are Coffee, Tea, Sisal, Maize, Flax, Wheat, Beans, and Barley.

There are many people with a limited capital, who will look for crops to grow which give a quick return on money and which require a minimum amount of labour, a scarcity of labour being one of the real problems of this country. The cereals are pre-eminently such crops. They are furthermore most important food producing crops and, with an increasing world population, are likely always to find a ready market and command a good steady price.

These reasons are quite sufficient to induce the average man to grow cereals and experience has shown that one or other of them can be grown all over the highlands, and that, if all goes well, they show a very good profit. Cereal growing, and in particular maize, is already one of the most important industries of the Colony.

The cereals chosen for discussion in this paper are Maize, Barley, and Wheat.

Large areas of the highlands are eminently suited to the maize crop. These areas belong to groups Nos. 2 and 3, that is to say, altitudes ranging from 4,500 feet to 7,000 feet, with a prolonged rainfall. The main districts are the Uasin Gishu Plateau, the Trans-Nzoia, and the Nakuru districts. The rainfall extends from about March to October, but it starts earlier in the year in the Trans-Nzoia and on the Plateau than it does in Nakuru. In these maize belts the soil is deep and is usually a lightish loam interspersed with heavier and richer soils. The climate is warm. Altitudes above 7,000 feet are generally too cold for maize, also it is not grown with much success in districts belonging to Group No. 4, as neither of the rainy seasons, except in exceptional years, is sufficiently prolonged for a long maturing crop such as maize.

* See also Wheat Cultivation by Natives, page 94.

Average yields of maize in the maize belts are probably, in a good year, about 10-15 bags of 200lbs. nett per acre, and this over large individual blocks of 1,000 acres or more. Smaller blocks have yielded up to 25 bags per acre. The figures just given may seem unduly optimistic, but they pre-suppose an adequate and timely rainfall and, equally as important, reasonably good farming. Given these conditions, and they are usually met with in the Colony, the above figures are by no means too large. They have been given in order to show that as far as soil and climate are concerned, large parts of the country are capable, even under present conditions, of producing as high yields of maize per acre as any country in the world. When better methods of farming are employed and well bred seed only is used, it can be confidently anticipated that these yields will be increased by 50 per cent. and that the maize belts of this country will become the Eldorado of the maize grower, though, on account of the smallness of the country, only a few individuals will be able to enjoy it. Even now, when scarcely any attempt has been made to improve the quality of seed maize, the average yields per acre is double that of South Africa, where much attention has been paid to the improvement of seed.

There are at present about 200,000 acres under maize, and a large proportion of the crop, consisting chiefly of Grade No. 2 flat white is exported to Europe. The price of maize depends largely on the Plate crop and varies here f.o.r. from about 8/50 to 13/- a bag. Gunny bags, and transport from the farm and to the rail cost together usually about 3/- a bag, so that the nett price a farmer obtains when maize is 10/- a bag f.o.r. is about 7/- a bag. The cost of growing maize is about £2 per acre, so that with a yield of 10 bags per acre, the profit per acre is about 30/-; with the yield of 15 bags per acre the profit is about £3 per acre. These figures are very rough, but they give some indication of the possibilities of maize growing in the Colony.

Barley is as yet very little grown, although it is perhaps more suited to the whole of the highlands than any other crop. The soil of Kenya Colony is par excellence barley soil, and the climate, particularly at the higher altitudes, equally good for it. If the time of sowing is judiciously selected it can be an absolute certainty that the weather will be dry at harvest, and this is important in so far as obtaining a malting sample is concerned. Most of the samples produced so far have been excellent malting samples, and those that have been sent to England have been pronounced upon most favourably and a high price offered. It is difficult to understand why more is not grown. It is hardly attacked by any pests or diseases except the smuts (which can easily be controlled), and the yields compare favourably with any country in the world, being about 10 bags of 150 lbs. nett to the acre. Perhaps the chief reason why only a negligible quantity is grown is that there seems to be some doubt in the minds of farmers as to finding a market for it. There is no local market for malting barley, and when the market is entirely foreign, there is always some difficulty and hesitation in starting the ball rolling. There is little doubt, however, that as soon as farmers realise that they are likely to find a good market abroad for Kenya malting barley that large acreages will be put under that crop. Most of the English malting varieties appear to do well here. It cannot be too strongly stressed that on the whole the soil and climate of the highlands of this Colony seem made for the growing of malting barley

and furthermore it is not affected by pests and diseases to the extent that other crops are. Hardly anything more will be said about Barley in this paper. It should be understood, however, that whenever, in the course of the succeeding pages, it is suggested that Wheat should be grown (as a rotation for example) what is really meant is that wheat should be grown on the wheat soil sand barley on the barley soils, unless the barley soils are properly manured for wheat. In stating that the climate of the highlands is everywhere suited to barley, two reservations should be made. It is likely that in some parts of the lower altitude districts the climate is rather too hot and in other parts that the rainfall is not sufficiently prolonged. In respect of these two conditions, wheat has the advantage over Barley.

Wheat can be grown all over the highlands, though it is chiefly grown in those districts in which maize cannot be grown with much success. The districts where wheat is the chief cereal are those over 7,000 feet, such as the Mau and Solai Escarpments, and the Timboroa and Londiani districts, and those under 7,000 feet with two rainy seasons, such as Machakos, and West and North Kenya. With the varieties at present in use, wheat yields up to about 10 bags of 200lbs. nett per acre, even with only 15ins. of rain on the crop. Conditions must be good for such a yield and perhaps 7 or 8 bags as an average is a more reasonable expectation. Even 7 bags per acre compares very favourable with any country in the world except England and Germany.

There were in 1925 about 25,000 acres under wheat. The wheat lands of the Colony give excellent quality grain. The total production is consumed locally (in fact, half the requirement in flour has still to be imported from India), so that, in conjunction with a high import duty, the price of wheat is very high, being at the present day actually 28/- a bag f.o.r. In view of the fact that production is likely soon to be in excess of local requirements calculation of profits on wheat growing should be based on a price not exceeding 20/- per bag. At 7 bags to the acre, and at 20/- per bag, the gross return per acre is 140/-. Taking the cost of production at £2 per acre, and the cost of bags and transport at 3/- per bag, the net profit per acre is £4. These figures are again only very approximate, but they show the possibilities of wheat growing in the Colony; and if the yield were raised to 10 bags per acre, the profit would be £7 per acre.

In discussing profits per acre both in regard to maize and wheat it should be realised that the price of land in this country is very much lower than in a country such as England, being indeed about a quarter the price, so that if yields are at all comparable, then the profits per acre in this country will be considerably larger than in England.

It will be noticed that the profits per acre in wheat seem likely to be larger than in maize. Wheat has further this advantage over maize, that it requires less labour for handling it. Wheat is handled almost entirely by machinery, whereas maize is harvested by hand. There are machines for harvesting maize, but they are not altogether satisfactory, and with most machines there is still the problem of the disposal of the maize stalks to be tackled. There is no question that it is certainly as profitable to grow 7 bags of wheat to the acre as 14 bags of maize. The higher price of seed wheat is offset by the fact that the cost of bags and transport of wheat is, under the condition stipulated, half that of maize.

It is by no means advocated that wheat should be grown instead of maize, but, where both can be grown, it is advocated that they should be grown in conjunction. The general tendency at present is always to grow the same crop on the same land year after year. The results of this policy are only beginning to become apparent. A dissertation on rotations is not the object of this paper. Suffice it to say that appearances suggest that proper mixed farming will gradually be forced on the settler. Shortage of labour, conservation of soil fertility, prevention of pests and weeds alone demand it. Where land is so cheap and large acreages of a crop are grown, green manuring is likely to be the most profitable humus making manure, and such a crop should be included in the rotation. In addition to the ordinary reasons, wheat works in well with maize on account of the economy effected in labour, implements, and power. Maize is sown several months earlier in the season than a quick-maturing wheat. There is sometimes not sufficient time between the harvesting of one crop of maize and the planting of another to get all the land into good enough condition for planting with maize. Some can be sown with wheat two or three months later, the soil being in perfect condition by then. In this connection it is better to put new land under wheat than under maize. Breaking starting at the same time in both cases, the land has longer to aerate, etc., before a wheat crop. With the two crops sown at different times a great saving in labour is effected as the same labour plants both crops, also the two crops are harvested at separate times, and the same labour performs that operation. As far as sowing is the case, this only applies if the maize has to be planted by a certain date, but in respect to harvesting two large crops at different times there is a great saving of labour in comparison with harvesting a crop twice the size at one time. Again, fewer ploughs, etc., need be used, and fewer tractors bought or fewer oxen bought and fed (requiring less land to be set aside for grazing) if the sowing and harvesting operations are spread out over a long period.

The time has come to turn to the other side of the picture. The actual average yield of maize is only eight bags to the acre, and that of wheat about three bags to the acre. A large proportion of farms give much higher yields than the above, but the average is pulled down by those farms which give practically no yield at all.

There is nothing much wrong with an average of eight bags of maize to the acre, but there is a great deal wrong with an average of three bags of wheat, and wheat cannot be compared with maize as long as this is so.

Maize is, however, a very low priced crop and in such a case any increase in yield is of the utmost importance and it costs little more to grow 20 bags to the acre than ten bags. The cause of low yields of maize in this Colony is due to several reasons. The chief are:—

(a) Growing the crop on land not suited to maize.
(b) Growing the crop on new land, and at too high an altitude.
(c) Weeds having been allowed to obtain the mastery.
(d) An unexpected drought.
(e) The ravages of cut worm and stalk borer.
(f) Poor seed.

Some account must be given in this paper of how the seed is to be improved; the other causes of low yields, except drought, will be eliminated in the course of nature.

It has been stated that under ordinary favourable conditions average yields of from 10-15 bags per acre could reasonably be expected and are obtained in the maize belts of this Colony. Were the seed well bred there is little doubt that these yields could be increased by 50 per cent. Planting at the usual rate and allowing for a good proportion of misses there must usually be at least 8,000 plants to the acre. If each plant gave one cob with only ½lb. of seed in it that would mean a yield of 20 bags to the acre. A half pound cob is a comparatively small one and many of the cobs harvested from the maize fields weigh a pound or more. Why is there not even a half pound cob on each plant? The answer is that the seed is poor, a large proportion of the plants yielding very poor cobs. South African maize varieties are being imported but they take some time to acclimatise and are not necessarily suited to this country. There is, however, a very mixed variety commonly in use throughout the country and which appears, on the whole, to do very well. This variety is probably a cross between Hickory King and Hickory Horse-tooth. The number of rows on the cobs varies from eight to 14. Experience shows that cobs with ten to fourteen rows yield best; indeed it might be said that a 12 row cob is the ideal at which to aim.

This Hickory Hybrid is acclimatised to the country and it is likely that better results can be obtained by breeding and selection within this hybrid than by importing foreign varieties. For the past three years officers of the Department of Agriculture have supervised this selection work on certain farms in the Nakuru area. The ordinary method of selection in the field has been adopted; any farmer of ordinary intelligence can do this work himself if he obeys the rules. The reason why the work is being supervised by a Breeder is that an attempt is being made to produce a new variety of flat white maize for this Colony. Coordination of work is therefore essential as it is important that plants and cobs should be selected every year which tend more and more towards the accepted ideal type.

It is too early yet to give any exact results of this work of selection, but a glance at the breeding plots in the Nakuru area will show that much has already been achieved. On one farm the selected seed has given a yield of five bags more per acre than the unselected seed. The plants are more even and more vigorous, the cobs are better placed, better covered and larger, and approximate more to the ideal type. In comparison with the rest of the fields there is a marked absence of those weak plants with poor cobs which both in themselves and as parents do so much to lower the yield of maize in this Colony.

From this work of selection alone it is likely that the average yields of the Colony will show a marked increase in a few years' time.

Maize does not suffer as seriously as other crops from pests and diseases. The chief are cut worm and stalk-borer, ear-rot, and "streak" disease. Ear-rot can be largely overcome by breeding plants with well-covered cobs.

If such a disease as "streak" or rust became serious on maize then the services of a Plant Breeder would have to be enlisted to try to save the crop. Plants would have to be purified for resistance to these

diseases by inbreeding them for many generations, the attenuated but almost homozygous plants would then be double crossed in the usual way, keeping resistance to disease and regaining vigour owing to a recombination of factors for yield. Fortunately, though there have been rust scares, there seems little danger of maize being destroyed by any fell disease in this Colony. That is one of the advantages of maize. As long as the cut worm and stalk-borer are defeated, and the rain holds out, there is little fear of the maize crop not coming to fruition.

As regards wheat, it cannot be too strongly stressed that the low yields are largely due to growing the crop on soils which are not wheat soils. It is to be hoped that this will be realised as time goes on, and that wheat will in future be confined to wheat land.

The other cause of low yields is rust. Some idea of the ravages of rust in this country will be realised when it is stated that year after year whole fields of wheat are completely destroyed by this disease. No wonder only 20,000 acres are under wheat and that after all these years this country is not yet supplying all its own requirements in flour. Heretofore a farmer has taken a grave risk in growing wheat, and yet it appears to be the only crop of its kind to grow at high altitudes, and at low altitudes with a short rainfall.

Some accounts must now be given of rust. There are three different species of rust in this country. These three species are *Puccinia graminis*, *Puccinia glumarum*, and *Puccinia triticina*. Either of the first two will alone completely destroy a crop of wheat. *Puccinia triticina*, though it does affect the yield, is not so serious in this country as the other two. *Puccinia graminis* is parasitic on the chaff, stem, leaves, and leaf sheaths of the wheat plant; *Puccinia glumarum* on the leaves, leaf sheaths and chaff; *Puccinia triticina* on the leaves and leaf sheaths. Not only are there three species of rust, but there are many biologic forms of each species. In the case of *Puccinia graminis* forty different forms have so far been isolated.

These biologic forms cannot be differentiated microscopically, they can only be differentiated by the reactions of certain varieties of wheat to inoculation by them. Some varieties are resistant to one or more and susceptible to others. Furthermore there are several degrees of resistance ranging from immunity to almost complete susceptibility.

There are two kinds of resistance to rust; these are physiological and morphological.

Physiological resistance will be described first. A spore is blown on to the wheat plant, there it germinates and forms an appresorium over a stomatal opening. The germ tube then enters the stomata and hyphae begin to grow between the cells of the plant. Immediately the cells of the wheat plant are touched by the hyphae they die. The consequence is that the mycelium is unable to find food and as soon as the food in the mother spore is exhausted the rust plant then dies. It is not able to mature and form pustules and all that is seen on the wheat plant is a small yellowish white fleck which consists of dead cells. If these white flecks are seen on a variety of wheat it is likely that the variety is immune to the biologic forms of rust which have attacked it. In the case of lesser degrees of

resistance it is not until haustoria have penetrated into the cells of the wheat plant that the cells die. In such cases a little food is extracted and the rust plant is able to mature and form a very small pustule surrounded by a yellowish white area. Such a variety of wheat would be highly resistant but not immune to the biologic form of rust which attacked it. Degrees of resistance to any biologic form depend on the relative size of the pustule to the yellowish white area around it.

In some cases it is possible that the germ tube has such an effect on the guard cells that they close as soon as the germ tube comes into contact with them. In such a case no flecks are formed as the germ tube has not been able to enter.

No satisfactory explanation has been given of this form of resistance to rust. In this connection the following quotation from a paper by C. B. Hurst is of interest: "It seems quite obvious that this must be due to physico-chemical relations between the host and the pathogene. As the pathogene cannot be grown in artificial culture media, a study of the problem is somewhat difficult. The most promising method of attack would seem to be to ascertain whether there are consistent differences in the physicochemical properties of different varieties. Determinations therefore were made of hydrogen-ion concentration, sugar content, etc. None of the observed differences seemed to be consistent or great enough to account for the differences in resistance. While it may be significant that the sugar concentrations in different varieties varied somewhat, too much importance should not be attached to these results. A study also was made of the reaction of spores of different biologic forms to certain physicochemical factors. It was found that the spore germination of two biologic forms was affected differently by hydrogen-ion concentration and by temperature. The form with the widest host range was able to withstand a wider range of variation than was the form with the narrower host range. This fact probably is of some significance, but just how much it is impossible to say."

It has often been thought that some varieties of wheat are morphologically resistant to rust. It has been shown that the number of leaf hairs, the number of stomata and the size of the stomata openings have no practical effect either way on the entry of rust germ tubes into the leaf. Stomatal movements do have an effect. That is to say appresoria may be formed over the stomata but owing to conditions of plant nutrition the stomata do not open to admit the germ tube. An unbalanced excess of nitrogen and a lack of silicic acid in the soil tend to make wheat more susceptible to rust. The growth of the wheat is luscious, moisture is retained permitting the easier germination of the rust spore, transpiration is greater causing the stomata to open and allow the entrance of germ tubes, the cell walls are thinner allowing the haustoria to penetrate more easily, and the proportion of chlorenchymatous to sclerenchymatous tissue is increased, thus allowing it more room for the development of uredinia. The morphological conditions above enumerated depend chiefly on environmental conditions and not on varietal characteristics and too much attention should not be paid to wheats resistant from such causes.

Rust can only develop in chlorenchymatous tissue. Therefore varieties in which collenchyma areas are small and separated by large

sclerenchyma areas will never be so seriously affected by rust as varieties in which the collenchyma areas are large. When collenchyma areas are small and well separated then the rust pustules can be long but only very narrow. When wheat is ripening the sclerenchyma areas are increased in proportion, so that a ripening wheat is less damaged by rust than one which is attacked in an earlier stage of growth. Early maturing varieties are therefore more likely to escape destruction by rust than long maturing varieties. Varieties which combine early maturity with small and well separated collenchyma bundles, and with stomata which open only infrequently and for a short time, and whose cell walls are hard, can be described as being morphologically resistant to all biologic forms of rust. Too much reliance must not, however, be placed on such resistance as it can be upset by environmental factors and in a good rust year such varieties might be very seriously affected by rust thought not so completely destroyed as morphologically susceptible varieties. The best form of resistance is physiological. Morphological resistance is a very dangerous trap for the unwary Plant Breeder. Owing to the possession of different kinds of this form of resistance some varieties escape severe infection by rust for many years. In fact it is only seldom and usually when they are on the point of ripening that any quantity of rust pustules appear on them. Great care must be exercised in looking for and examining the types of rust pustules in order to determine the real resistance of the variety. If a variety is pure and only one plant in the field shows susceptible forms of rust pustules, then the whole variety must be classed as susceptible. Whatever the reaction varieties of wheat may give to inoculation with rust in the laboratory the real practical test of rust resistance is what happens in the field, but it requires a practised eye to tell exactly what is happening.

It is likely that one of the reasons why the resistance of a variety is commonly supposed to break down after a few years is that it never was more than morphologically resistant, but had not been properly examined, and a good rust year overcame it. Another reason is that the district in which the variety was growing was invaded for the first time by a biologic form of rust which had not so far existed there and to which that variety was not resistant.

All the biologic forms of each species of rust do not necessarily exist in one country, and those which exist say in India are not necessarily the same as those which exist in Kenya Colony. It is obvious, therefore, that wheats which are resistant to rust in any one country are not necessarily so in any other country, and wheats which are resistant to any one species of rust in one district of this country may not be so in any other district. In fact out of the many hundreds of supposedly resistant varieties imported into this country only two or three have proved immune to one or other of the rusts.

The problem of breeding wheats resistant to rust in a Colony with such varied climates as Kenya Colony is no easy one. Wheat has only been grown here a few years so that natural selection has not played its part in separating out resistant types. Further, in no other country is wheat more completely destroyed by rust.

In the light of the experience gained during the past few years of the occurrence of rust, Kenya may be divided into three main classes of districts, and the basis of this division is one of altitude.

Class I consists of those districts of an altitude of from 4,500 feet to 6,500 feet (includes Groups No. 3 and 4 districts). Here *Puccinia graminis* and *Puccinia triticina* occur, but not *Puccinia glumarum*.

Class II. consists of districts of about 6,500 to 7,500 in altitude (identical with Group No. 2 districts). Here all three rusts occur.

Class III. consists of those districts of an altitude of 7,500 feet and upwards (identical with Group No. 1 districts). Here *Puccinia glumarum* and *Puccinia triticina* occur. *Puccinia graminis* has been seen but does not appear to flourish.

The problem to be solved by the Plant Breeder can briefly be postulated as follows:

Four months maturing wheats resistant to *Puccinia graminis* have to be bred for Group No. 4 districts.

Four months and six months maturing wheats resistant to *Puccinia graminis* have to be bred for Group 3 districts.

Early and long maturing wheats resistant to *Puccinia graminis* and *Puccinia glumarum* have to be bred for Group No. 2 districts.

Early and long maturing wheats resistant to *Puccinia glumarum* have to be bred for Group No. 1 districts.

If resistance to *Puccinia triticina* can be tacked on to all these wheats so much the better.

Other important characters which all these wheats must possess are high yield, strong straw, good milling quality and close chaff (this last point being difficult to achieve in a hot climate). One cross does not always produce in the progeny all the characters desired and it is often necessary to cross some of the progeny again with other wheats in order to produce the ideal one.

There should be three breeding stations in different parts of the country with a suitable number of varietal testing stations attached to them, if the work is to be satisfactorily done.

It may be said at once, why not concentrate all the work at 7,000 feet and breed wheats resistant to all three rusts there which would then be suitable for all parts of the country. The answer to that is that the choice of types would be very much restricted and in any case, it would be necessary to have stations in other districts for a further testing of types. It would probably *simplify* the work if the *main* breeding station were at 7,000 feet.

In conclusion a little must be said on what has been done in the way of producing rust resistant wheats.

One of the differences between wheat and maize is that maize is heterozygous and wheat homozygous. To produce mutations, and segregation and recombination of characters, wheat has to be artificially cross-fertilised. During the succeeding generations of natural in-breeding the factors segregate out and pure and desirable combinations are eventually obtained. From the date of the original cross it is likely to be a matter of at least ten years before any resulting variety is issued to the public. Many hundreds of varieties of wheat have been imported into the country, but none of them have been of any value agriculturally, and at the same time resistant to rust. A very few of them have been resistant to one or other of the rusts and thus have been useful as parents for crosses.

The first Plant Breeder was appointed in 1912. He made a number of crosses and produced several varieties of wheat such as Equator, Cross 13/5, Cross XI., and Bobs Reiti, which were thought to be resistant to rust. His work was interrupted by the war.

The present Plant Breeder was appointed in 1921. A breeding station was erected near Nairobi where wheats are bred for resistance to *Puccinia graminis*. Great progress has been made with this work and many useful types, of from four months to six months maturity time, and resistant to *Puccinia graminis*, are now pure and ready for multiplication. Unfortunately most of them are susceptible to *Puccinia triticina*, but by a further cross it is hoped to rectify this in time. Many of the types now being grown near Nairobi will have to be transferred to a breeding station in the Rongai Valley as they take about six months to mature, and would be useful for that and other similar districts. There is fortunately one, though only one, variety of wheat in the country immune to *Puccinia graminis*. This variety is called Red Egyptian, and is immensely useful as a parent for crosses.

Another breeding station was erected at Njoro at an altitude of 7,000 feet. Here wheats are bred for resistance both to *Puccinia graminis* and *Puccinia glumarum*. Fortunately at any rate one variety, Equator, is resistant to *Puccinia glumarum* and can be used as the other parent for a cross with Red Egyptian. Unfortunately both are long maturing wheats and so early maturity will have to be achieved by further crosses of early maturing wheats with some of the progeny of the Equator and Red Egyptian cross. The breeding work at Njoro is progressing fairly favourably and useful types resistant to both rusts are now segregating out. Wheats which appear resistant to *Puccinia glumarum* and *Puccinia graminis* are further tested for resistance to *Puccinia glumarum* at higher atitudes.

In addition to the two breeding stations there are six varietal testing stations. As the work progresses, it is becoming increasingly difficult to manage and it may become necessary, unless further staff is provided, to confine the activities of the Plant Breeding Branch, insofar as wheat breeding is concerned, to producing wheats suitable for lower altitudes only, leaving the higher altitudes to look after themselves. Considering the distances separating them, four breeding stations is rather a tall order for the present meagre staff to cope with.

It will be realised by now that wheat simply cannot be grown in the Colony until the rust problem is solved. In order that farmers should not have to wait ten years after the arrival of the present Plant Breeder before they had rust-resistant wheats to grow, some 500 selections were made from the mixtures of wheats left behind by the previous Plant Breeder. An exhaustive trial of them has been made all over the country for five years. The result of these trials shows that Equator is the only wheat which can be grown at altitudes above 7,500 feet, it being resistant to *Puccinia glumarum* but susceptible to *Puccinia graminis*. And Kenya Governor—issued for the first time last year—is the only wheat which can be grown at altitudes below 7,000 feet, being highly resistant to *puccinia graminis*, but susceptible to *Puccinia glumarum*. There is no wheat as yet in sufficient quantity for issue for altitudes of 7,000 feet except Durum wheats such as Golden Ball and Groot Korn.

Farmers who grow any variety of wheat other than the two mentioned are running a grave risk of losing their crop through rust. Equator should not be grown below 7,500 feet nor Kenya Governor above 7,000 feet. Both these wheats are capable of yielding 10 bags

to the acre. Kenya Governor has already this year yielded 11 bags to the acre from 84 acres, the chief objection to it being that it is inclined to lodge.

Kenya Colony is now approaching a sound position as regards wheat growing. Next year there will be sufficient seed of the two above-named varieties to supply all the country's requirements.

If the services for Cereal breeding are satisfactorily maintained, then in four or five years' time the happy agricultural condition of this country prophesied earlier in this paper, should indeed be realised. Kenya maize shoud become world famous.

THE CHAIRMAN (Mr. Holm) said that in connection with the yields of maize in Kenya, although the general average was high, and on some individual farms very high, the position was not wholly satisfactory, and much improvement could be effected. In the fields there were too many barren and weak stalks, and when examined in the crib it was found that there were too many nubbins. Maize was a crop which deteriorated in quality unless regard was paid to selection. The importance of this was now being recognised by maize growers.

Mr. SIMPSON was very pleased to see the attention that was being paid in Kenya to cereal crops; he said that would be of value to the neighbouring territories, in that if success attended the endeavours of Kenya it would be able to meet the demands of its neighbours for wheat and wheat flour.

THE CHAIRMAN (Mr. Holm) stated that the Kenya Government, recognising the importance of wheat to all East African territories, had invited Professor Sir Roland Biffen to visit Kenya to advise on the question of wheat breeding. It had been estimated that an increase of 20,000 acres under wheat would meet the present demands of Kenya, Uganda and Tanganyika in respect of wheat flour; there was also the likelihood of an increase in the demands of these territories, due to an increase in European population and to native peoples changing over to the consumption of wheat.

Mr. SIMPSON thought that the Baganda would not change to the consumption of maize products but only to wheat.

THE CHAIRMAN (Mr. Holm) said on behalf of the Department of Agriculture, that it would be pleased to arrange for the supply of seed-wheat to other territories. It was not unlikely that wheats raised in Kenya would prove more rust-resistant in East Africa than wheat from other countries.

Mr. WORTLEY observed that Kenya had already supplied a number of wheat samples which were now being tested in Nyasaland.

THE CHAIRMAN (Mr. Holm) thought that as railways developed in Tanganyika, it was not unlikely that acres suitable for wheat cultivation would be opened up.

Mr. KIRBY agreed.

THE CHAIRMAN (Mr. Holm) said that in the areas most suitable for the growing of barley, the most important consideration was weather conditions at time of harvesting. It had been found that barley of good quality could be grown, but if it was not harvested during dry weather its value for export was greatly reduced. With more experience it might be possible to reduce these risks.

The Chairman conveyed the thanks of the Conference to Mr. Burton.

CHAPTER VIII.—MISCELLANEOUS.

ADULTERATION OF FARM PRODUCTS AND METHODS OF PREVENTION OTHER THAN COMPULSORY INSPECTION AND GRADING.

Mr. KIRBY said that in a country with many inland centres of production and many ports, a system of inspection and grading was too costly, and, if the cost was to be borne by the industries concerned, it would prove too great a burden wherever the local production was not large. In Tanganyika there were five important ports, including two on Lake Victoria (which, however, might be taken as one for purposes of port inspection, since the port of consignment from the coast was at present Mombasa, and later, for Mwanza, would be either Mombasa or Dar-es-Salaam). Some other means of preventing the consignment of adulterated produce was necessary. The most important crop in this connection in Tanganyika was ground-nuts. Machine cleaning and re-bagging at the ports would not, it is thought, be expensive and, if made compulsory and operated as a (self-paying) Government service, would be effective. This method was in use in the Gambia, which was a large exporter of ground-nuts, with, however, a single port. Enquiries were in progress to ascertain its suitability for shelled ground-nuts (which was the form in which this product was exported from the Territory) and its suitability also in respect of cost. The problem of cost with any crop, or by any method, had less importance for other East African Dependencies, since in those the points of egress were confined to one (except, possibly, in Northern Rhodesia). The methods to be evolved, however, would have interest for them.

(The above was circulated in the form of a note under T.C.(C)Ag.9.)

Mr. KIRKHAM stated that the Agricultural Produce Adulteration Decree came into operation in Zanzibar on the 1st of January, 1926, and was directed particularly to avoid export of adulterated cloves, or cloves containing more than a certain percentage of moisture. It was hoped to inspect all shipments, but the machinery necessary to perform this would have increased the staff greatly and would have interfered unduly with exporters who attempted to catch a fluctuating market. The compulsory inspection was abandoned, and it was simply laid down that it was an offence to sell, export or deal in cloves below the standard. Check inspections resulting in prosecution were made. An improvement in the quality of the produce had resulted. It was a choice between that method and full inspection and grading. In the case of Tangnayika, possibly a similar result would be obtained.

Mr. SIMPSON knew of no methods except legislation, education, or commercial methods. Legislation was rather cumbersome and expensive to run but was more efficacious. In Uganda the power of prosecution in cotton markets was acting as a deterrent to adulteration, but was not entirely satisfactory. It was intended that all local sales should be registered so that the original seller, the ginner, could be reached in the case of wrong grading and made to pay the difference in the value.

THE CHAIRMAN (Mr. Holm) said the grading of Agricultural products was practicable in the case of some, but in others the onus of grading was placed upon the owner or shipper, and inspections were

made of a prescribed proportion of the products. In Tanganyika, however, with its many ports, the system would be more difficult to apply than in Kenya with its single port. If it was considered that only ground-nuts of a definite standard should be sent out, a scheme of inspection might be arranged and a charge for this service be made. Treatment should be carried out at the point of despatch; if done at the port extra expenditure would be involved in handling and storage in godowns. Certain difficulties might be created in respect of special export rates if the goods were consigned to private godowns. The additional costs would eventually be borne by the producer.

Mr. KIRBY stated that the Tanganyika Government did not intend to make provision for inspection. The cost would be prohibitive in proportion to the value of the crop. In cases of adulteration, it was difficult to decide which was the place of production as the ground nuts changed hands many times between the original producer and the final exporter.

THE CHAIRMAN (Mr. Holm) thought that if legislation prescribing a fair average quality standard were enacted and inspections were carried out, improvement in quality and conditions would be effected.

After discussion the following Committee was appointed to consider and report upon this matter: Messrs. Kirby, Simpson, Wortley, Kirkham and the Chairman (Mr. Holm).

The Committee later submitted the following conclusion, which was unanimously approved:—

(a) That the principle of official compulsory grading and/or inspection of agricultural produce, prior to export, is sound and should be applied wherever practicable in the interests both of producer and the trade.

(b) That, in order to give effect thereto, legislation is essential.

(c) That charges calculated to cover the cost of the grading and/or inspection service should be levied.

(d) That in cases where it is found impracticable for the inspector to perform the grading the onus should be placed upon the owner or shipper to grade or prepare the product, in accordance with the standards laid down; in such cases, the service may take the form of inspection only of the whole or a prescribed proportion of the shipment.

(e) That in the case of grading and/or inspection under such legislation, official certificates as to grade or standard should be issued where expedient.

(f) That the legislation should take the form of a general enabling ordinance, following the examples of South Africa and Kenya, with provision for the application of the ordinance to any particular product, and the framing of rules dealing specifically with the grades or standards, and the services of grading or inspection or both.

THE CHIEF AGRICULTURAL PRODUCTS FOR WHICH A SATISFACTORY MARKET COULD BE DEVELOPED IN EAST AFRICAN TERRITORIES.

(Colonel R. B. Turner, C.M.G., D.S.O., Trades Commissioner for the Union of South Africa attended for the discussion on this item.)

COL. TURNER said that there were very few openings in British East Africa for raw agricultural products from South Africa; there was a small but growing trade in fresh deciduous fruits, also in horses and pure bred stock. Strangely, there was quite a fair trade in ostrich feathers, which were imported into Kavirondo. There was little hope of increasing the trade in agricultural raw materials to any extent, but there was a considerable opening for manufactured articles. There was a possibility of there being an importation of fruit but Kenya regulations regarding pests and diseases placed restrictions thereon.

THE CHAIRMAN (Mr. Holm) said that the Conference at a later date would consider the question of legislation covering importation of fruit.

Mr. SIMPSON asked what articles manufactured from South African agricultural products were likely to be exported to East Africa.

COL. TURNER stated that the most likely were tobacco, jams, canned and dry fruits and wines. After the war East Africa was regarded as a sort of dumping ground for South African products; a portion of a big consignment of wine imported then was still on the hands of the importers and was being offered at 60% below cost.

This wine was in very bad condition and was giving South African wines a very bad name. Steps were being taken to endeavour to remove this consignment from the market altogether and to give present day South African wines a chance. Very good reports had been received regarding the dried fruit from Kenya merchants. With regard to tobacco, Kenya was considered by the Tobacco Combine as falling within the sphere of the Northern Hemisphere, and tobacco was being mainly imported from factories in that zone. However, there was an increasing trade in South African and Rhodesian tobaccos and cigarettes. The shag trade at present was wholly in the hands of Holland.

THE CHAIRMAN (Mr. Holm) asked if there was anything that the Conference could do and if Col. Turner could give any information regarding the " Chapell " Report. The question of reciprocity might be considered by the Conference: South Africa had prohibitions against Kenya produce.

COL. TURNER observed that the East African Dependencies could not give preference to any Dominion so long as the Congo Basin Agreement was in force. The Agreement was in force until 1929.

THE CHAIRMAN (Mr. Holm) said that the Government of the Union had prohibited the importation of Kenya maize on the grounds of the presence of disease, and during a period of shortage of supplies in South Africa it might be advantageous to both countries to obtain maize from Kenya.

COL. TURNER, in reply to Messrs. Kirby and Simpson, stated that there was no manufacture in South Africa of agricultural implements and machinery suitable for export to Kenya, but that South Africa acted as an *entrepot* for such machinery.

He further stated that there was a considerable trade carried on with South Africa in many products of East Africa, such as sisal, copra, oil seeds, etc.

Mr. SIMPSON said that a great deal of cotton seed had been exported to Durban from Uganda, but the fear on the part of South Africa of the Pink Boll worm had closed the market.

Mr. KIRBY said that it was hoped to establish a market for *Nicotiana rustica*, a native crop in Tanganyika, but the heavy duty levied in South Africa had prevented any development of the kind.

Mr. WORTLEY asked what openings there were in South Africa for Nyasaland tea and coffee.

COLONEL TURNER said that there was a possible opening for Nyasaland tea, and Nyasaland tea exporters had been put into touch with possible importers in South Africa. There might be a market for coffee, as much Kenya coffee was entering South Africa. The various points raised would be placed before the South African Government.

Mr. SIMPSON observed that the good shipping services between South Africa and East African ports should facilitate trade activity.

COLONEL TURNER stated that the balance of trade was in favour of Kenya and Uganda, if coal be not considered.

On behalf of all delegates, Mr. Holm thanked Colonel Turner for the information he had given them.

POLICIES OF NORTHERN RHODESIA AND NYASALAND IN REGARD TO EUROPEAN SETTLEMENT.

Mr. KIRBY stated the reasons why the information was being sought, pointing out the importance of ascertaining whether means of attraction for settlement in a country were likely to be successful before the Government concerned embarked on costly schemes, such as railway construction, intended primarily to serve such settlement.

Mr. WORTLEY said that Nyasaland was regarded by Government as being suitable for both European and native development. The Shire Highlands, in particular, were suited to European settlement. The Government was sympathetic to both European and native agriculture. There was no active propaganda to encourage European settlement, as most of the land suitable for such settlement, within easy reach of the railway, had already been taken up. Information regarding agricultural prospects in Nyasaland was given in a handbook entitled "Hints for Settlers." The Nyasaland Government had never offered inducements to settlers, as had been done by Canada and Australia. At present, only short term leases were given, but it was hoped that long leases would soon be granted. Rent varied from 1/- to 2/- per acre. There had been a very large increase in settler population during the last twelve years.

Mr. SIMPSON said that the Uganda Government had not attracted European settlers. There was very little land that was suitable for European settlement within reach of transport. In the days of the land boom a great deal of land was purchased from natives by aliens. At present Europeans were settling in the Toro district, where leasehold was obtainable on application. The rent was revised every thirty-three years. The best area for European settlement was

on Ruwenzori, but this was far from a means of cheap transport. On the whole, Uganda was not suitable for European settlement; the labour supply was not plentiful. As in all tropical regions, the climatic conditions enabled a man to obtain the necessaries of life with the minimum expenditure of energy. There was thus no need for such natives to go out to work. The settler population had decreased since 1913.

Mr. Kirby thanked the Directors of Agriculture of Uganda and Nyasaland for the information given.

CHAPTER IX.

SUMMARY OF CONCLUSIONS OF AGRICULTURAL SECTION.

1. Manures.

That the attention of the Governments of East Africa be drawn to the possibility of the existence of deposits useful as fertilisers in the various territories, and that such Governments be asked to consider the recommendation that their respective Geological Departments should make this matter a prominent subject in their normal investigation and report.

2. Transportation of Stock.

(a) On the statement presented by the Trades Commissioner for South Africa, it is noted that the freight and other charges on stock imported from South Africa are considerable, and it is requested that the Trades Commissioner should make representation with a view to effecting reductions.

(b) It is considered that the rates on livestock from England to East African ports are excessive, are limiting the importations of stock, and are, therefore, retarding livestock improvement in East African territories. It is, therefore, urged that representations be made to the Shipping Companies requesting that a substantial reduction be offered.

3. Compulsory Dipping of Cattle by Natives.

That under existing conditions the compulsory dipping of cattle by natives is, at present, impracticable over extensive areas.

4. Wheat Cultivation by Natives.

That wheat growing by natives should be encouraged in areas suitable to the crop, not only for improving the food ration for the native population, but also for production for purposes of sale when satisfactory transport conditions exist.

5. Prevention of Adulteration.

(a) That the principle of official compulsory grading and/or inspection of agricultural produce, prior to export, is sound and should be applied wherever practicable in the interests both of producer and the trade.

(b) That, in order to give effect thereto, legislation is essential.

(c) That charges calculated to cover the cost of the grading and/or inspection service should be levied.

(d) That in cases where it is found impracticable for the inspector to perform the grading the onus should be placed upon the owner or shipper to grade or prepare the product, in accordance with the standards laid down; in such cases, the service may take the form of inspection only of the whole or a prescribed proportion of the shipment.

(e) That in the case of grading and/or inspection under such legislation, official certificates as to grade or standard of quality should be issued where expedient.

(f) That the legislation should take the form of a general enabling Ordinance, following the examples of South Africa and Kenya, with provision for the application of the Ordinance to any particular product, and the framing of rules dealing specifically with the grades or standards, and the services of grading or inspection or both.

C. Transport.

That, having regard to the difficulties of transporting agricultural produce to the railway systems and the heavy cost thereof, it is desired to invite the attention of the Governments of the East African Territories to the importance of reducing the capital and running costs of motor vehicles, in particular, by every means within their power.

7. Native Agriculture.

(a) It is desired to impress upon the Governments of East Africa the great importance of a pronounced agricultural bias being given to the education of Africans in these territories, where agriculture is almost the sole industry upon which the sustenance and advancement of the African peoples depend—a principle which has already been emphasised by the Phelps-Stokes Commission.

(b) It is further considered that, for the development of native agriculture, a staff of Africans trained in agriculture and capable of performing the duties of agricultural instructors is essential; and it is urged that the necessary provision should also be made for the systematic training of African teachers in agriculture for schools in native areas.

PART III.

COTTON.

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PART III.
COTTON.

The normal constitution of the Cotton Section was as follows:

Mr. S. Milligan (Chairman).....Empire Cotton Growing Corporation, South Africa.
Mr. A. G. Bailey.....Kenya.
Mr. G. S. Cameron.....Southern Rhodesia and Empire Cotton Growing Cotton Corporation.
Mr. H. C. Ducker.....Empire Cotton Growing Corporation, Nyasaland.
Senhor M. Grillo.....Portuguese East Africa.
Mr. P. Koch.....Union of South Africa.
Mr. G. W. Nye.....Uganda.
Mr. F. R. Parnell.....Empire Cotton Growing Corporation, South Africa.
Senhor L. de Sâ Pereira.....Portuguese East Africa.
Mr. E. F. Salter.....Empire Cotton Growing Corporation, Northern Rhodesia.
Mr. R. C. Wood.....Empire Cotton Growing Corporation, Swaziland.

Technical Secretary ... Mr. P. Booth.

Other members of the Conference attended for certain items.

CHAPTER I.
SUMMARY OF WORK OF COTTON SECTION.

(Chiefly concerning plant breeding and seed distribution.)

The Cotton Section of the Conference was composed generally of representatives of the Empire Cotton Growing Corporation from South Africa, Northern and Southern Rhodesia, Nyasaland and Swaziland, and also representatives of the Agricultural Departments of South Africa, Southern Rhodesia, Kenya, Uganda, and Portuguese East Africa, while for special items other representatives were also present; this Section also held several joint meetings with the Agricultural and Entomological and Mycological Sections to discuss matters of common interest.

The Section at its preliminary meeting considered that the chief object of the Conference was the utilisation of the opportunity offered to co-workers on Agricultural problems in Africa to meet each other and thus obtain the acknowledged benefit from consultation and discussion which such occasions presented. The best of this opportunity, anyhow so far as those interested in Cotton were concerned, would, it was considered, be made if discussions were as informal as possible; formality generally had the effect of suppressing discussion among the more junior members and encouraging prepared statements by the more senior members, a course of action which was unlikely to be productive of good results in Cotton problems.

The first subject taken for discussion was Plant breeding and Seed distribution, the one following naturally from the other. To those who had had the experience of new crops in tropical conditions the great value of plant work was fully apparent. The first thing after all in dealing with crops was to find varieties and strains to fit varying conditions; if these could not be found, then the growing of the particular crop became uneconomical and in fact impossible. One could not work against nature without paying for it; on the other hand, by working with nature, not only could normal yields be increased, but the effects of adverse conditions, such as drought, disease and insect pests could be mitigated to no small extent.

SECTION I. COTTON BREEDING.

The following is a brief account of the Cotton Breeding work in the various countries represented at the Conference:—

I. Nyasaland.

From a large collection of types, obtained both locally and from abroad, a number of promising strains of cotton have been retained for growing and examination in the current season, 1925/26.

These strains fall into two main groups as regards their staple lengths, the one with staples about 1 1-16 inch, the other with staple about 1 3-16 inches. It is not yet known to what extent they differ in other characteristics considered generally.

The majority of these strains are in the stage of progeny rows. That is they are represented by progeny rows each obtained from a single plant selection of the preceding year. Two strains have been sown as bulks and of these one will have to be discarded on account of Jassid susceptibility.

Up to this season, 1925/26, all work has been done at the Makwapala Cotton Station which is situated at an elevation of about 2,100 feet above sea level. From and including the 1926/27 season it is proposed to duplicate the work at the Port Herald Cotton Station which lies at about 150 ft. elevation.

It is considered that these two stations cover the main types of climatic conditions under which cotton is grown in Nyasaland.

All plants in all progeny rows are being harvested separately each into its own bag and comparisons are being drawn between the progeny rows in respect of the evenness of their component plants as regards Lint and Seed characteristics, judgment being used in deciding which of the progeny rows are to be examined in this fashion, susceptibility or otherwise to Jassid attack being an important factor, provided that is that the rows are even vegetatively in so far as ordinary observations go.

It is proposed to carry on the strains derived from these progeny rows in future seasons by taking for sowing as further progeny rows a number of plants which lie nearest the mean for the rows.

From and including the 1926/27 season it is hoped that it will be possible to ensure self fertilisation in the case of all plants grown in the progeny rows. The tendency, therefore, will be, as time goes on, to establish nucleus stocks of strains which will become more and more homozygous with each year that they are grown.

A preliminary test will be made each season with part of the bulk seed from the progeny rows which appear to be particularly promising, using flowering and fruiting studies to decide which strains are worthy of inclusion in full field trials in the following season. The balance of the bulk seed being sown in each case in an increase plot.

Full field trials will consist of plots, sown with seed obtained from the increase plots, arranged in such a way as to give a known degree of accuracy to the results obtained. All new strains used in these trials will be tested against the ordinary field crop as a whole as well as against one another.

The most superior strain will be further bulked with a view to replacing with it the ordinary field crop as time goes on. The aim will be to retain the pure parent stock and from this obtain further supplies of seed wherewith to renew the general seed stocks as required.

Any new varieties obtained in the future will be first sown in observation plots and then selections from them will be passed to the progeny rows for purification.

II. Union of South Africa.

Work and methods employed are on similar lines to those described above under "Nyasaland." There are two distinct climates involved, represented by the middle and low veldts. There are two plant breeding stations, at Rustenburg and Barberton, representative of the two climates. The main plant breeding problem at Rustenburg is the general improvement of existing types with a comparatively short season as a limiting factor. A preliminary issue of seed from plants selected by the Plant Breeder has been made this year. This will be followed by pure strains. This year's results indicate suitability to local conditions and show marked improvement in quality.

At Barberton, representing low veldt conditions, the main deciding factor appears at present to be Jassid, which, combined with boll worm, is threatening the industry in many areas. There seems to be every hope that a means has been found to combat this pest through jassid-resistant strains; multiplication of one of these is proceeding.

III. Swaziland.

The Cotton specialist arrived in Swaziland in September, 1925, and has seen one complete cotton season. An area of some 20 acres at Bremersdorp was leased, and on this, in addition to the various series of experimental plots, fairly large areas of the five commonly grown varieties were planted, as well as a few small plots of introduced American varieties, all of which served as material from which selections were made. Some 130 plants were marked in the field, the characteristics to which the greatest importance was attached being resistance to the attack of jassid. This pest appeared rather late in the season, but its attack was considered sufficiently severe to afford a test of the resisting qualities of the selections. These are in process of elimination and at present some 40 are still retained.

The programme for the coming season is to plant out progeny plots from the survivors, and for this a small area which is known not to have grown cotton for many years has been selected. Besides

this, multiplication plots are being arranged, both at headquarters and at different places through the country to test one of Parnell's strains from Barberton, which, it is thought, may be suitable for widespread distribution next year. A few other strains from Barberton, not yet available on such a scale, will be tested and multiplied at headquarters.

IV. Southern Rhodesia: The Government Cotton Breeding Station at Gatooma.

The late commencement in making the preliminary arrangements, coupled with an unsatisfactory planting season, rendered the first year's work extremely difficult and it is just possible that too much was attempted in the circumstances.

Work Undertaken during 1925-26 Seasons:

An area of 40 acres was put down to Improved Bancroft. Seed from the best cotton crops in the country was used, and it was hoped that it would be possible to rogue out a large number of improved seed for distribution the following year. As this crop had to be replanted at a very late date, however, the scheme was abandoned, owing to the unsatisfactory yield which the crop produced.

An attempt was also made to carry out comparative trials of five exotic varieties of cotton imported from the U.S.A., the local variety, reputed Improved Bancroft, being used as a standard of comparison in the trials. The exotic varieties under trial were the following:—

Acala.
Express.
Trice.
Tanguis.
Delfos.

These were grown in 1-20th acre plots and repeated four times. Owing to the haste with which all work connected with the Station had to be undertaken, it was not possible to pay due regard to obtaining an ideal scatter, in order to obviate marginal effects. Growth, flowering and bolling records were kept, while plant diagrams were made of a number of plants of each variety together with diagrams of other varieties which were grown in observation rows.

Meteorological Observations:

Rainfall and temperature records (max. and min.) were kept from the commencement of the season, but additional records will be kept in future now that the Station is equipped with the requisite instruments such as a thermograph, barograph, wet and dry bulb thermometers, and sunshine recorder.

Scientific Equipment:

A sum of £300 was voted for this purpose, but it was not possible to utilise it all before the end of the financial year. Sanction to carry over the grant to the following year was willingly accorded by the Treasury and it is satisfactory to record that the Station is now well equipped in this respect.

Programme of Work for 1926-27:

This will not be decided upon definitely until it is known whether the additional assistant Plant Breeder will arrive from the United Kingdom in time to help with the lay-out and planting of next year's experiments.

The following, in brief, is an outline of the work to be undertaken, if all goes well:—

1. Meteorological observations and recording of same.

2. Growing in observation lines of some seventy varieties of Cotton, which, so far as is known, have not been grown in Southern Rhodesia previously: (a) On unmanured land; and (b) on heavily manured land, with the object of discovering a variety or selection from a variety which will give a dwarf or medium sized plant, when grown in rich soil.

3. Growing in observation lines of field selections made last season under conditions (a) and (b), as indicated above.

4. Recording, usual observations and measurements on selected plants of each variety and strain, grown on the Station.

5. A repetition of the variety trials conducted last year, with a view to ascertaining to what extent such trials can be relied upon.

6. A comparison of Cotton plants grown—(a) in the insect proof cage, with (b) Cotton plants of the same variety grown under field conditions.

7. Observation rows from seed of the different varieties, grown under cage conditions last year, with a view to noting whether or not any crossing has taken place.

8. " Increase " or " small bulk " plots of what appears to be the better varieties among those which were grown in last year's variety trials. The results of these trials are not yet to hand, nor is it likely that they will give any indications when they arrive, but three out of the five varieties appeared to be much better than Improved Bancroft.

V. Uganda.

Aims.

At the present time breeding and selection is being done with the following aims:—

Improvement of yield.
Purity of strain.
Maintenance of a regular 1 3-16in. staple.
Maintenance of quality.
Resistance to Black arm disease.

Selection.

Single plants are selected from the growing crop in native plots and from progeny rows of the previous year. From these plants progeny rows are grown and 15 plants in each row are very carefully observed, the following records being taken:—

Daily flowering records.
5 day boll records.
Weekly growth measurements.

All plants are self fertilised by the tying method.

Every boll is picked separately and the following characters are recorded for each boll:—

Loculus number.
Seeds from loculus.
Weight of lint.
Weight of seeds.
Lint length.

For each plant Lint Index and Ginning outturn are worked out.

As a result of the analysis of the above observations the most promising rows are selected for growing in ¼ acre increase plots in which 100 plants are selected at random for boll records and these are taken as the mean of the plot. Lint from these plots is sent home for spinning tests and if the report is favourable the best strain is grown in a large increase plot and also grown in a yield trial with types in general cultivation. If results are satisfactory yield trials are held at various sub-stations and then the strain is grown on in bulk and eventually distributed to natives.

Cross Breeding.

Although the difficulty in dealing with large F3 and F4 generations is realised, a few crosses are being followed up.

Apart from selection work, the question of yield improvement is being tackled by means of field experiments, such as sowing date, spacing and method of culture.

In the case of newly introduced varieties, progeny rows are grown for several years and similar records to those mentioned above are made.

Complete meteorological data are obtained and used for correlating with observations on progeny rows.

The opportunity offered by the Conference for the discussion of the technique of plant breeding and experimental work on Cotton was made full use of by members of the Section.

The following subjects received special attention:—

1. The technique of field experiments;
2. The technique of plant breeding;
3. The keeping and utilisation of records;
4. The position with regard to cross breeding;
5. Methods for the economical multiplication of seed and its distribution;
6. Treatment of seed before sowing;
7. Methods of Testing New and Improved Strains of Cotton in different parts of the country;
8. Mass methods for improving or maintaining the quality of Cotton in the districts;
9. Interchange of strains between African countries;
10. Introduction of varieties from countries outside Africa;
11. Wild cotton in Africa.

SECTION II. SUMMARY OF THE DISCUSSIONS.

1. Technique of Field Experiments.

In discussing the merits and demerits of field experimental methods the view was generally held that whatever method was used it should be so designed as to permit the degree of accuracy being determined.

Attention was also called to the inaccuracy which may be involved in comparing varieties which are very different in habit and which may therefore be differently affected by the cultural conditions adopted; *e.g.*, a uniform spacing for large and small types is obviously unsound.

2. Technique of Plant Breeding.

It was agreed that mass selection must be considered only as a temporary method during the time necessary to establish pure strains at plant breeding stations. Members of the Section compared their methods of management of their breeding blocks, the question of selfing receiving special attention. The advantages and disadvantages of stitching, tying, and bagging methods were discussed. The latter method possesses particular advantages in boll worm infested areas in the protection afforded against the attack of these pests. In Nyasaland bagging was found necessary on this account and a special method of converting a square of gauze into a bag by means of a rubber ring was described (*vide* Minutes of the Cotton Section, page 148).

The elimination of strains by means of observation rows appears to be the general practice in South and East Africa as a preliminary to full field trials of the survivors.

3. The Keeping and Utilisation of Records.

The Section accepted as an axiom the necessity for making the fullest possible observations of all factors affecting the plant and its yield, especially in the form of continuous records. Of even greater importance was the keeping of these records in such a way as to facilitate correlation. It appeared from the discussion that an opportunity exists in South and East Africa for the application of accurate knowledge obtained from correlated records embracing the incidence of insect attack in relation to climatic and soil factors and plant development. This may be of special importance in regard to the losses due to boll worms. For the obtaining of these records it was considered necessary that experimental stations be adequately equipped. (A list of suitable apparatus appears in the Minutes of the Section. See Enclosure, page 146).

4. The Position with regard to Cross Breeding.

This subject was thoroughly discussed and the Section was in agreement with the opinion of one of its members in saying that crossing ought to be valuable, but, in practice, did not appear to be so. If crossing is to be of any value, an early start should be made, for it takes a long time before any results are achieved.

5. Methods for the Economical Multiplication of Seed and its Distribution.

This subject is of special importance in view of the urgency of supplying suitable strains with as little delay as possible. The main principle involved is the avoidance of all possible loss through thinning and through drought, flood or insect attack. The advantage of

avoiding thinning by single seed planting is obvious, and methods of assisting germination, protecting seedlings against insects, etc., are, in consequence, of great importance. The matter is receiving general attention and members of the Section have arranged to communicate with one another when any definite results of their investigations have materialised. The extent to which single seed multiplication can be carried out will depend on local circumstances. In South Africa where the holdings are extensive and where the growers are keenly interested in obtaining superior seed as quickly as possible, fairly large areas are to be sown in this way during the ensuing season; where native cultivation is the rule such methods will be limited by the size of such seed farms as are under European control. It is equally necessary to avoid losses in the next stage of multiplication, that is, after the seed has passed out of the hands of the first multiplying agency. This brings up the whole question of the policy affecting distribution. A sharp division of opinion on this subject was apparent in the discussions; some members supporting concentration on the large block system, others advocating a system of distribution in small quantities over a large area. Except in Uganda, no distribution system appears to have been fully tested in South and East Africa. The matter will doubtless be solved in the manner best suited to the countries concerned.

6. Treatment of Seed before Sowing.

This question was brought up with special reference to the sulphuric acid treatment for de-linting. In view of the conflicting experiences of various members of the Section in the use of this process and the work regarding the effects of various seed treatments on the subsequent growth of the plant (*vide* Kidd and West), it was considered advisable that the subject should be fully investigated by some central institution, if local investigation proved insufficient.

7. Methods of Testing New and Improved Strains of Cotton in different parts of the Country.

The difference between cotton cultivation in South Africa, where the growers were non-native, and in Nyasaland, Tanganyika, and Uganda, was discussed in detail; the question of regular supervision and large scale tests was examined and the advantage of having Agricultural officers of the district in charge of Experimental plots was brought to light.

The Section was of opinion that it was no good arranging for tests and records unless these were accurately carried out and that any such tests should be carried out under the supervision of the Agricultural Department. Inspections, with notes, should be made as frequently as possible and at any rate at intervals of not greater than one month. Regular periodic pickings should also be made if possible. Where sufficiently competent men were in charge meteorological records should also be kept.

8. Mass Methods for Improving or Maintaining the Quality of Cotton in the Districts.

In this connection a paper was read by the Director of Agriculture. Tanganyika, in which he described methods of:—

(a) Selection of suitable plants as sources of seed—the processes being repeated in successive seasons;

(b) Selection of seed in bulk from areas where good crops have been obtained. (Co-terminously with this work, selection along the lines described above in (a) is carried out in every season.)

(c) A third method, viz., mass introduction of seed of desirable type from countries or districts of similar climate, due precautions being taken against the introduction of insect pests;

(d) Mass selection of seed on the assumption that fuzziness in the seed is associated with superior lint.

The Section agreed that, in the absence of plant breeding in the strict sense of the term, the Director of Agriculture, Tanganyika, had no alternative to mass selection. The question of mass selection had already been discussed when it was agreed that mass selection must be considered only as a temporary method during the time necessary to establish pure strains.

With regard to selection of seed on appearance, it was considered that the success of the procedure suggested would depend on whether the fuzziness of the seed in the mixture dealt with was really associated with good quality lint. This was a matter for investigation, and could not be accepted without actual trials. The experience of most members of the Section was that no linkage existed between fuzziness and good quality lint.

9. Interchange of Strains between African Countries.

Three points were brought out in discussion:—

(a) The desirability of information regarding existing or new strains being available in a readily accessible form;

(b) The necessity for guarding against the loss of a strain which might at the moment not appear useful, but which, owing to some special characteristic, at a later date might become valuable;

(c) The question of nomenclature of strains.

With regard to (a) it was agreed that the Empire Cotton Growing Corporation be asked to prepare and publish a list, which should be kept up to date by the issue of supplements, of all varieties and strains of cotton in cultivation throughout the world, with a description of the characteristics of each variety and the conditions under which it was grown.

(b) It was recommended that cotton breeders in their reports should give details of such strains as they were themselves rejecting, but which, owing to special characteristics, might be of value to others; small stocks of such seed should be stored locally against further requirements.

(c) Uniformity of nomenclature of strains in Africa was considered desirable. So far as South and East Africa were concerned, it was considered that new productions should be distinguished by the name of the producing station followed by a distinguishing number, or letter, or both.

10. Introduction of New Varieties from Countries outside Africa.

It was considered that much benefit would accrue from the broadening of the basis for selection by the introduction of promising varieties from outside, especially from America. It was stated that the difficulty in obtaining suitable varieties through the usual channels

was the existence of numerous types passing under the same varietal name, and the want of information with regard to their characters made it a difficult matter to procure what was actually desired.

It was agreed that the Empire Cotton Growing Corporation be asked to assist plant breeders in obtaining seed varieties as they may require.

11. Wild Cotton in Africa.

The Section was much interested in a paper by Baron Surcouf (T.C.(C)Cot.13. See page 156) in reference to a wild cotton discovery by him in Portuguese East Africa. Baron Surcouf attended a meeting of the Section for the purpose of reading this paper. A discussion followed. Information was given as to other types of wild cotton which had been observed and collected in neighbouring territories.

The Section thanked Baron Surcouf for his interesting paper and said that they would be very pleased to receive specimens of the seed from him and to grow the cotton; members undertook to publish the results of any observations made.

12. Discussions with Entomological and Mycological Section.

Meetings of the combined Cotton, Entomological and Mycological Sections of the Conference were held on the 24th August. The Minutes of the meetings will be found in the records of the Entomological and Mycological Section, see Part IV., Chapter II.

As regards Mycology, it was unfortunate, from the point of view of the Cotton Section, that neither of the two Mycologists present were in any way engaged on Cotton problems.

Bollrot diseases were discussed to some extent, in connection with Stainer attacks; and a statement to the effect that, it appeared probable that Blackarm disease might be dealt with by the production of immune strains, was made by one member of the Cotton Section.

Altogether it appeared that, with the exception of Bollrots, Cotton diseases attributable to mycological causes, are, relatively speaking, of minor importance in the territories represented at the Conference.

As regards insect pests on Cotton, it appeared that a very different state of affairs existed to that regarding fungus pests. There seemed to be no doubt in the minds of the members of the Meeting that the major obstacles to the successful production of Cotton in the territories are the attacks and depredations of insect pests.

In the course of the discussion particular mention was made of Bollworms of different kinds—Stainers, especially in reference to the occurrence of Bollrot diseases and their transmission; Apion beetles; Aphides and Jassids.

As regards the major pests, the whole of the discussion may be summed up in the statement made by the Chairman of the Meeting (Mr. Fuller) to the effect that, in the opinion of all the Entomologists present, further investigation was essential in all items. Reasonable progress appeared to have been made in the study of Jassid attack and its control, a note describing which is supplied by a member of the Cotton Section and is included in the Minutes of the Meeting. See page 181.

The Chairman of the Cotton Section, in thanking the members of the Entomological and Mycological Section for the assistance and information they had given at this meeting to the members of the Cotton Section, laid great emphasis on the desirability of the members of the Cotton Section doing all in their power to help the Entomologists in their most difficult and varied problems.

Signed on behalf of the Cotton Section,

S. MILLIGAN, *Chairman.*

Nairobi,

27th of August, 1926.

CHAPTER II.

AN ORGANIZATION OF MARKETING IN A YOUNG COTTON INDUSTRY.

(This item was dealt with by the Cotton and Agricultural Sections jointly.)

Mr. KIRBY made a statement as follows:—

(Circulated to the Conference as paper No. T.C.(C)Cot.8).

In Tanganyika Territory the war made it necessary to start the cotton industry afresh; and for this a system of auction markets for native seed-cotton was introduced in 1922 into most of the districts where seed-cotton was grown, the scheme being extended to other districts as is shown in the table at the end of this paper, as more staff in the Agricultural Department became available. The purposes of the adoption of this system (applicable of course in an area only as long as its output of cotton is comparatively small) were: (1) to ensure by close competition among buyers a fair price to the native producer; (2) to supply a means of teaching and controlling directly the sorting of cotton by natives.

In the first stage the method employed was to advertise the date of the periodical auction sales, and at these the Agricultural Officer issued tickets, for the seed-cotton brought by natives and weighed in by him, each bearing particulars of the weight. The seed-cotton in its different grades was then put up to auction in lots of a weight convenient to buyers; the value of each small parcel as delivered was calculated in accordance with the price obtained at auction; and the native sellers were paid for their seed-cotton by the Agricultural Officer on the day of sale, or at the latest the day after.

As the output of native cotton quickly increased it became impossible for the periodical auction markets to be conducted in this detailed way, and the scheme was widened by putting up to auction

the day's deliveries of the different qualities (without guarantee as to quantities), each native then delivering his parcels of those qualities at the stores of the successful bidders (as the deliveries of different qualities would often be purchased by different buyers), where he was paid by the buyer under supervision and assistance by the Agricultural Officer. One advantage of this method of selling large deliveries of undefined quantites was the elimination of the small speculator, who was not in a position of certainty for providing cover for his purchases.

The quickly continued increase in production necessitated a still further widening and simplification of the system; and this is the method in operation for cotton auction markets at the present time. In this, deliveries of seed-cotton during periods of a week, a fortnight, or a month (depending on the quantity likely to come in) are sold by auction at a convenient centre in the district just before each period to which the deliveries refer, samples of the different qualities being exhibited by the Agricultural Department at the auction and at the buying centres, and the successful bidders entering into an undertaking to pay the prices at which the deliveries were knocked down, and to grade according to those samples. All this is carried on under the activity and inspection of a District Agricultural Officer, who where requisite is assisted by temporary market supervisors (Europeans). Among the other advantages, this system possesses that of greater popularity among native sellers than the former ones, as it supplies buying centres open at any time in the picking season for deliveries, instead of periodical markets affording only interrupted opportunities for selling.

There is no doubt that the quick increase in native cotton growing in the Territory and the high opinion on the Liverpool market of the cotton thus produced are due in the first place to these markets, through which natives were encouraged by fair prices for the different qualities to grow cotton and to sort it carefully; the latter having become a habit that has continued where Cotton Auction Markets have been replaced by (central) Cotton Markets. Their success has been in the first place due to the energy and enthusiasm of District Agricultural Officers doing the work for them, and to the freely given assistance of Administrative Officers (who have had to conduct them alone in some cases) and of the Treasury (which has provided cash facilities), as well as (in Rufiji) the help of the officials of the Empire Cotton Growing Corporation.

The table at the end of the paper (which of course does not give figures of total production) shows that the quantity of seed-cotton sold at the auctions in any one year quickly reached (in 1924) over 4,500 tons for which native producers received more than £120,000. In the four years the total amount of seed-cotton dealt with at the auctions was more than 7,300 tons for which native growers were richer by a sum exceeding £180,000. The table also demonstrates well the quick decline in 1925 in the total quantity of cotton handled at these markets owing to their replacement by open cotton markets in the Morogoro District (with Kilosa), Lindi, and Tabora, their substitution in the first of these districts having the greatest effect on account of its predominating output.

TANGANYIKA TERRITORY. SEED-COTTON BOUGHT AT AUCTION MARKETS, 1922-25.

Area.	1922.		1923.		1924.		1925.	
	Kgs.	£	Kgs.	£	Kgs.	£	Kgs.	£
Morogoro & Kilosa	136,479	3,079	749,435	22,211	2,314,523	67,797(3)	—	—
Rufiji	371,275	5,556	349,827	6,185	506,520	9,341	350,081	5,335
Lindi	6,007	146(1)	237,422	6,776	598,464	15,480	11,000	205(5)
Mwanza	—	—	11,800	299(2)	67,424	1,646(4)	81,007	849
Kilwa	—	—	—	—	134,383	3,317	123,187	2,834
Dar-es-Salaam	—	—	—	—	131,204	3,757	90,433	2,293
Bagamoyo	—	—	—	—	417,222	11,851	14,105	170
Pangani	—	—	—	—	143,650	4,112	300,056	6,810
Tabora	—	—	—	—	143,250	2,030	—	—
Bukoba	—	—	—	—	81,571	1,906	11,820	113
Totals	513,761	8,781	1,348,484	35,471	4,538,211	121,237	981,689	18,609

Total seed-cotton sold by auction 1922-25 : 7,382,145 kgs. worth £184,093.

(1) Mikindani only.
(2) Experimental auction at Nassa.
(3) Including some seed-cotton from Bagamoyo and Mahenge.
(4) At four centres.
(5) At Tunduru.

Mr. SIMPSON, in the ensuing discussion, explained the methods of selling cotton in Uganda in the eary stages of the industry.

Mr. KIRBY said that in Tanganyika auctions were held at certain centres in the smaller producing districts. In the districts producing most cotton, selling took place at licensed stores in market centres. In reply to Mr. Holm, he said that agricultural officers were able to undertake the supervision of cotton buying as this occurred during times when the agreiultural officers were not busy.

Mr. MILLIGAN said that in the Punjab, when a change was being made from Indian to American Upland cotton, a similar scheme was employed. At first the purchase of small lots was made on a system of a premium over the native cotton. Later on auctions were instituted, but a great deal of cotton was not sold at these, their chief value being to establish the price. Most of the sales took place after the auction on the basis of the price at the auctions. At a later date the prices ruling on the Liverpool market were published in the markets and sales took place on the basis of these.

Mr. WORTLEY stated that in Nyasaland cotton production by natives was increasing. A system whereby all cotton was purchased by the British Cotton Growing Association had been instituted. Half of the profits realised by the Association went to Government who did not share losses. This system had had the result of greatly increasing the production of cotton grown by natives.

Mr. VAN DEN ABEELE remarked that in the Belgian Congo only licensed ginners were allowed to purchase in the official markets and then only up to an amount depending upon their capacity. The minima prices of cotton, according to grade, were fixed and published one month before their application. (See Ordinance of the 1st August, 1921.)

CHAPTER III.

THE COTTON INDUSTRY IN UGANDA.

(This item was discussed by the Cotton and Agricultural Sections jointly.)

Mr. SIMPSON made the following statement:—

The Cotton Industry of Uganda is unique in many respects and holds a leading position amongst the new Cotton-growing fields within the Empire. Cotton exports for 1925 equalled 196,038 bales of 400lbs. each, valued at over four and a half millions sterling, or practically 92% of Uganda's total exports. 22,000 tons of cotton seed were exported, valued at £123,000, so cotton and cotton seed were responsible for 94.35% of Uganda's exports during 1925.

The industry is entirely one of native production, and is the result of the cultivation of hundreds of thousands of small cotton plots in all parts of the Protectorate.

It is estimated that 617,324 acres were planted with cotton in 1925, compared with 572,814 acres in 1924.

The cotton acreage is distributed amongst the four Provinces, as follows:—

Eastern Province	383,613 acres
Buganda Province	200,000 ,,
Northern Province	26,829 ,,
Western Province	6,882 ,,
Total	617,324 acres

The Cotton is of good quality from 1 1-8 inches to 1 3-16 inches in length, strong and fairly regular.

Uganda Cotton commands a ready sale on the world's markets at prices ranging from 250 to 300 points on American "middling," *i.e.*, from 2½d. to 3d. per lb. above American "middling," and the demand for this type of Cotton is practically unlimited.

Owing to the position of Uganda and its distance from the sea, in development work it has been necessary to concentrate on highly priced products. Government has therefore given every possible assistance to the extension of the Cotton industry, and to-day's results are due to propaganda work carried on during a period of nearly twenty years.

The development of the industry has been retarded owing to the absence of a complete and efficient system of cheap transportation, which railways only can provide, but the Railway system is now being steadily improved and extended.

The Uganda Government has throughout taken a practical interest in the industry and its development has been guided along certain well-defined lines.

Fortunately, Uganda possesses a good system of main roads which have been gradually extended and developed, with the result that the increasing crops of cotton have been moved with little difficulty to the inadequate railway system. When all the cotton had to be carried by head loads, the production of cotton was strictly limited. Seed cotton is very bulky, easily damaged by adverse weather conditions, and 70% of its weight is cotton seed—a low priced product. It was

therefore essential for ginning facilities to be provided in the interior within the areas of production and cotton ginners have gradually built ginneries throughout the whole of the cotton producing areas.

Although head porterage of cotton has been practically eliminated, except that the growers carry their produce for sale to a ginnery or market, internal transport costs are still very high. The use of cattle for transport purposes is still extremely restricted, owing either to the presence of tsetse fly or the incidence of cattle diseases. The cotton crop is therefore transported from the cotton markets and ginneries almost entirely by motor transport. This form of transport is efficient, but very expensive, and cannot be used over long distances for such a low-priced product as cotton seed.

Many thousands of tons of cotton seed are thus annually destroyed at ginneries in the interior, owing to the high costs of internal transport.

To guide the industry along practical lines of development a large number of cotton rules have been drawn up and put into operation.

Many of our tribes which grow large quantities of cotton are very primitive and it has been necessary to guide them at every stage of the crop's development. Cotton markets have been established throughout the country and every grower of cotton is enabled to market his own crop personally and to carry away the results of his labours in hard cash.

The Government has been well repaid for its practical interest in the cotton industry; a large annual revenue both direct and indirect is collected as a result of this industry becoming firmly established, whilst the excise duty on cotton at six cents of a shilling per lb. of lint added £216,988 to general revenue last year.

The main work of the Department of Agriculture consists of:—

(a) Arranging that all cotton growers are provided with the best cotton seed available, free of charge.

(b) Directing the planting and cultivation of the crop; also picking and sorting of the cotton by the growers.

(c) Inspection of markets, methods of marketing, inspection of ginneries, cotton stores, and methods of ginning and baling, and the marking of the bales.

(d) Improving and maintaining the quality of the cotton grown, and increasing the yield per acre, by the carrying out of experimental work in all directions.

(e) Encouraging the use of implements and oxen for the cultivation of the land. (Four European Ploughing Instructors are constantly at work.)

(f) Encouraging a system of rotation of crops in which cotton and food crops are the main crops. This ensures that, whilst the area under cotton increases, the food producing areas are automatically increased.

(g) Strong control in every direction to keep down insect pests and diseases, and to see that all cotton plants are uprooted and destroyed every year.

Mr. MILLIGAN, in thanking Mr. Simpson for his remarks, asked if any rotation was practised in conjunction with cotton growing.

Mr. SIMPSON said that in districts where Wimbi can be cultivated the natives have been taught to plant their seed between the rows before uprooting the cotton sticks. After the Wimbi has been harvested they are expected to plant ground-nuts, and the soil will not carry cotton again for two years.

In the course of a discussion arising out of a question regarding the pressing of cotton seed for oil, Mr. Simpson said that the export of oil did not pay, as freight had to be paid upon the empty oil containers. The climatic conditions of Uganda were not conducive to the production of a good oil cake. Transport costs made the use of cotton seed cake as a manure prohibitive. The production of oil in Uganda would not become a paying proposition until there was a local market for it and its bye-products. The Uganda cotton industry had to bear this disadvantage.

In the course of further discussion, it was agreed:—

That as long as no local markets existed it was more economical to export the cotton seed than to export oil in special containers.

Mr. HOLM asked the Conference to convey to the Director of Agriculture of Uganda and his staff congratulations upon the wonderful success of the cotton industry of that Protectorate; he would have preferred someone else to have spoken on this subject, inasmuch as Kenya was not an important cotton producing country, but the success of Uganda had benefitted Kenya Colony greatly in many ways.

CHAPTER IV.

THE COTTON INDUSTRY IN SOUTH AFRICA.

(This item was dealt with by the Cotton and Agricultural Sections jointly).

Mr. KOCH made a statement on the Cotton Industry in the Union of South Africa, as follows:—

The annual world production of cotton lint is normally about 20,000,000 bales of 500 lbs. each, being the quantity actually consumed in the cotton mills, and exclusive of the large amounts used locally by primitive tribes in China, India, Africa, and other countries. At present South Africa produces only a small amount of the world's supply. The farmers in this country have for many years (since about 1860) been trying to produce cotton, but until 1910 their efforts met with failure owing to lack of knowledge of cultural methods and want of gins and means of conveyance.

However, cotton culture has made rapid progress since 1910, especially in the Middle and Low veld of the Transvaal and Natal, where conditions are ideal for the crop. The future is now most promising. The great possibilities of cotton in those parts are causing widespread interest, and a realisation of the very important part it will play in the development of the vast, sparsely-populated and fertile regions in the hotter parts of the Union. The periodical

roughts to which large areas of the country are subject have further oncentrated attention on this plant. Where maize and other crops ailed cotton grew, stood up to the trying conditions and yielded a rofitable return. Consequently every year sees an ever-increasing creage under cotton, so that at present many thousands of acres are evoted exclusively to this purpose.

In 1909 the Tobacco and Cotton Division of the Department of griculture was formed for the purpose of encouraging the levelopment of the industry. Experiments were planned and plots stablished in a number of likely areas in order to ascertain by actual ield trials how the cotton plant would thrive under various local soil nd climatic conditions. Seed of a large number of promising arieties was imported and experimented with, with the result that fter a thorough trial of years the undesirable ones have been liminated, and such remaining ones as " Improved Bancroft " and ne or two others have been improved beyond recognition. To-day hese compare very favourably with any of the best commercial arieties grown in the United States of America.

Innumerable difficulties had, and still have, to be faced and vercome, and as valuable data has accumulated and experience ained the industry has grown.*

The production of cotton in the Union is still comparatively mall, but the industry was started on a sound basis and can now be onsidered permanently established. The assistance given by the Empire Cotton Growing Corporation since 1924 has been of material dvantage to the further development of the cotton industry in South Africa. The Union Government greatly appreciated the help which has been forthcoming from the Corporation. The close co-peration between the officials of the Cotton Division of the Department of Agriculture and the officials of the Empire Cotton Growing Corporation augurs well for the future of this industry in the Union. The expansion of cotton growing in this country is now laiming wide attention. The available lands for future development, here soil and climate are favourable, comprise, generally speaking, he whole of the Middle and Low Veldt. These areas include large tretches of country in the Western Transvaal north of the Magaliesberg Mountains, in the northern and eastern Transvaal, Swaziland, Zululand, northern and eastern Natal, and numerous iver valleys in Natal and the eastern Cape Province. Cotton is also ery successfully grown under irrigation in Griqualand West and along the Orange River.

The approximate acreage planted during the 1925-26 season was 700 for the Transvaal, 36,000 for Natal and Zululand, 4,100 for the Cape Province, and 4,000 for Swaziland, making a total of 81,000 acres; whereas the estimated potential acreage is three millions for the Transvaal, half a million for Natal and Zululand, 100,000 for the Cape Province and slightly less than half a million for Swaziland, making a grand total of over four million (4,000,000) acres. It is considered that there is more potential wealth in the future cotton fields of South Africa than in the gold mines of the Witwatersrand.

In order to cope with this rapidly developing agricultural ndustry an appreciable number of up-to-date cotton ginneries have

* See Table A at end of Statement.

been erected. In the Union alone 22 (twenty-two) registered ginneries have been established, and in Swaziland one.

The cost of production and profit naturally depend largely on the value of lint, the yield, and the distance from the ginneries. Even if these should be quite favourable sufficient labour must be available at reasonable wages. Without an ample supply of labour it is almost hopeless to grow cotton profitably. Fortunately, most parts of the Union suitable for the growing of cotton are well supplied with cheap native labour.

The cotton plant, however, is subject to the attacks of numerous insect pests. But in South Africa the only two really serious pests are boll-worms and jassid, insects which in some areas are threatening the very existence of this most promising industry. The work on breeding jassid resistant varieties by the Cotton Division has been handed over to Mr. Parnell of the Empire Cotton Growing Corporation, and a solution now seems in sight. The boll-worm trouble is being investigated very seriously by the Department. In connection with Cotton pests also it is a great pleasure to record the readiness with which the Corporation has come forward to assist in every way possible. With further assistance and co-operation from the Empire Cotton Growing Corporation it is confidently expected that some solution will be found out of the very serious boll-worm menace. Once this difficulty is overcome there will be no limit to the development of cotton growing in South Africa.

TABLE A.

SUMMARY OF COTTON INDUSTRY IN SOUTH AFRICA.

1. Annual Production of Cotton Lint in the Union.

Year.	Annual production in pounds.	Percentage of increase over previous year.
1910-11	13,623 ...	—
1911-12	32,025 ...	135.1
1912-13	32,471 ...	1.4
1913-14	71,654 ...	120.4
1914-15	215,990 ...	201.4
1915-16	227,562 ...	5.3
1916-17	243,885 ...	7.2
1917-18	283,128 ...	11.9
1918-19	764,584 ...	170.1
1919-20	1,094,763 ...	43.2
1920-21	1,169,298 ...	6.8
1921-22	1,096,182 ...	(decrease)
1922-23	2,749,109 ...	150.8
1923-24	3,824,442 ...	39.5
1924-25	6,774,423 ...	77.1
1925-26	12,000,000 (estimate.)	

2. Approximate Areas Planted 1925-26:—

Transvaal	37,000 acres
Natal and Zululand	36,000 ,,
Cape Province	4,100 ,,
Swaziland	4,000 ,,
Total for the Union & Swaziland	81,000 ,,

3. Potential Approximate Areas:—

Transvaal	3,000,000 acres
Natal and Zululand	500,000 ,,
Cape Province	100,000 ,,
Swaziland	400,000 ,,
Total for the Union & Swaziland	4,000,000 ,,

4. Number of Registered Ginneries:—

The Union and Swaziland 24

5. List of Technical Officers of the Tobacco and Cotton Division:—

Administrative and Executive	1
Tobacco and Cotton Advisers and Experimenters ...	9
Cotton Breeders	1
Cotton Graders	2
Seed Cotton Classifiers (Temporary and Non-technical)	3
Total ...	16

6. Entomologists Working on Cotton Pests:—

Department	2
Seconded by the Empire Cotton Growing Corporation	2
Total ...	4

7. Chemists Engaged on Cotton Fertilizer and Soil Investigations 1*
(* Seconded by the Empire Cotton Growing Corporation.)

8. Officers of the Empire Cotton Growing Corporation lent to the Union Department of Agriculture:—

Administrative	1
Cotton Breeder	1
Field Officer	1*
Total ...	3

(* Exclusive of the two entomologists and one chemist mentioned.)

9. Experiment Stations:—

Transvaal	2
Cape Province	1
Total ...	3

10. Co-operative Cotton Fertilizer Experiments:—

In representative Cotton areas 18

11. Seed Multiplication Farms (barring Experimental Stations):

In suitable areas 10

Mr. KOCH, in reply to a question by Mr. Simpson, stated that experiments were being conducted to determine the best rotations for different areas. The rotations now being employed were three or four course rotations containing a legume.

Mr. HOLM asked what view was held regarding cotton as a profitable crop. He would like to have some expression by the Conference regarding the effect upon the yield obtained through European supervision and labour. In Uganda, cotton was produced purely by Africans; in South Africa by Europeans with African labour: in Queensland purely by European effort.

Mr. KOCH said Cotton would give a profitable return in South Africa under conditions when other crops would not be profitable. At 9d. per lb. cotton cultivation would pay.

Mr. MILLIGAN said a yield of a bale of seed cotton, or about 150 to 160 lbs. of lint per acre is considered to be a fair yield. The actual outlay on the crop does not on an average exceed £3 per acre.

Mr. CAMERON said that in Southern Rhodesia the cost of production was considered to be £2 10s. per acre. It had been estimated that the cost of harvesting cotton was very little more expensive than that of maize.

In the course of a discussion upon the average yields of cotton, it was stated that in Uganda 150 bs. could be accepted as an average. In Tanganyika 120 lbs. had been reached, but the average was lower. In the United States the average yield was less than 170 lbs. per acre.

Mr. SIMPSON said that in Uganda the policy adopted to increase the yield of cotton was, firstly, the issue of selected seed; secondly, instruction in better cultural methods.

Mr. WORTLEY remarked that in Nyasaland it appeared that the native yields were quite as high as those of the European.

Mr. KIRBY said that in Tanganyika, methods similar to those employed in Uganda were followed for the improvement of the yields of native cotton, but attention was given first to obtaining better husbandry, in order to give the best chances of success to the better cottons. Planters did get better yields than the native growers, but the cotton was not graded as well as the native grown.

Mr. HOLM drew attention to the importance of increasing the yields and said that generally under European methods larger yields were obtained than under native methods. He asked if the yields obtained by native growers could not be improved by improved methods of cultivation and in other ways.

Mr. SIMPSON did not consider that methods of cultivation as practised by Western nations were of the very high importance usually attributed to them in tropical countries. The method of cultivation suited to a country depends upon the conditions of that country; Western methods of cultivation were based upon the conditions of Europe and could not be applied directly to countries

where totally dissimilar conditions obtained. A system had to be worked out for each country and if the proper system were employed, no matter who applied it, the result would be the same.

CHAPTER V.

NATIVE COTTON INDUSTRY IN THE TERRITORY OF THE MOZAMBIQUE COMPANY.

(This item was dealt with by the Cotton and Agricultural Sections jointly.)

SENHOR L. DE SA PEREIRA made a statement as follows:—

The native Cotton industry in the Territory of the "Companhia de Mocambique," principally in Chemba, has given very satisfactory results, and all the matters regarding Cotton are receiving the careful attention of the Government. Instructions have been given to the authorities and the crops are frequently inspected by the Technical Officers of the Department of Agriculture, especially the Entomologist, Monsieur le Baron de Surcouf.

Regarding insect pests and diseases, a very important work has been carried out last year—the disinfection and fumigation of all seed cotton for sowing purposes. This has been general in the Territory, also in the European crops; and I had the honour to suggest to my Government the compelling of disinfection by regulation. The "Companhia de Mocambique" will supply the necessary means to carry out the disinfections and fumigations at all the ginneries. An official seal will be put on the bags of disinfected seed cotton, and the selling of non-sealed bags for sowing purposes will be strictly forbidden. The operation will be carried out under the supervision of the Department of Agriculture. Last year, all this work at Chemba has been controlled by Monsieur le Baron de Surcouf.

Taking into consideration the suitable conditions of the soil and climate, the exceptional adaptability of the native to cotton growing, I hope a great development of this industry will be a fact after few years.

The most important native growing exists at Chemba. This district is, relatively, very populous, and the population is growing rapidly. Formerly, the variety grown was Uganda, being now a special type of some interest.

All the seed cotton picked by the natives is sold to the Mozambique Industrial and Commercial Company Limited, this operation being controlled by the Administrative authorities of the 'Companhia de Mocambique." The cotton is ginned and baled at Nova Chupanga in the Mozambique Industrial factory. The natives make two classes of seed cotton, white and dirty. The seed for sowing purposes is taken from the best classes of cotton, and the following instructions have been given to the ginnery:—

1. To reserve for sowing the seeds taken from the first pickings.

2. To inspect the arrivals of seed cotton, in order to see if the seeds are suitable for sowing purposes. The rules to follow in this examination are:—

   (a) The analysis of the staple (length and elasticity).

   (b) The percentage of germination of the seeds.

3. To gin separately the different varieties, and to clean the floor and pipes before changing the lots.

4. To gin the fuzzy seeds in linter-gins (or to remove the fuzzes by the application of sulphuric acid).

5. To pass the seeds selected for sowing purposes through a sieve.

Recently the authorities of Chemba put forward a proposal to establish a seed-farm.

(This statement was circulated to the Conference as Paper No. T.C.(C)Cot.14.)

CHAPTER VI.

COTTON TAX IN UGANDA.

(This item was dealt with by Cotton and Agricultural Sections jointly.)

Mr. HOLM, who raised this question, said that the Kenya Government's actions with regard to the Cotton Tax had met with a great deal of opposition, but it had been felt that the same procedure which had been adopted in Uganda should be followed in order to protect Uganda interests. The Ordinance had been modified in that the tax might be waived in certain areas where the tax would not affect Uganda; this had taken place in the Coastal area. A flat rate tax such as was imposed at present was apt to be a hardship on growers when the price was low; would it not be possible for the tax to be imposed on a sliding scale depending upon the price of cotton?

Mr. SIMPSON said that cotton was bringing much money into Uganda; all the services in connection with the production and sale of cotton were given free. It was felt that, as the industry was so prosperous, it might directly bear some of the cost of the services supplied. An Excise Duty was placed upon cotton and the money thereby collected was expended upon buildings for cotton research, experiments and roads. Recently the Cotton Tax had passed into general revenue which last year benefitted to the extent of £217,000. The great success of the Uganda cotton industry had been rendered possible by the Cotton Tax. The reason why Kenya imposed a Cotton Tax was that in the districts contiguous to Uganda, cotton was grown and it would be easy for Uganda growers to evade the Tax by sending their cotton into Kenya.

The tax at present was 6 cents of 1/- per lb., but from the 1st January, 1927, a graduated tax would be instituted. The amount of the tax for the year would be fixed in December of the previous year upon the price of June American middling futures on the Liverpool Cotton Exchange on the last business day in December. The rate would be according to the following schedule:—

Price of June American Middling Futures. pence per lb.	Tax per lb. Cents.
6 or less	nil
6.01—7	2
7.01—8	3
8.01—9	4
9.01—10	5
10-01 13	6
13.01—14	7
14.01—15	8
Over 15	9

Mr. KIRBY remarked that a similar tax should be levied in Tanganyika, but the idea was not being regarded sympathetically.

Mr. WORTLEY said a similar tax had been instituted in Nyasaland on native grown tobacco and the proceeds were to be devoted to the development of the native tobacco industry.

Mr. HOLM said the principle had been applied elsewhere. In South Africa a levy can be imposed upon an article by the Minister of Agriculture, and a Board, acting in conjunction with the Department of Agriculture, dealt with the disposal of the funds obtained.

Mr. KOCH stated that in South Africa, in the case of the Cotton Levy, the Minister might dispose of the funds as he thought fit, but he was advised by the Directors of the Central Co-operative Cotton Exchange.

Mr. HOLM was very glad to hear of the " sliding scale " to be introduced in Uganda in connection with the Cotton Tax, a method which had been urged by Kenya for some time past.

After some further discussion of the subject the following Conclusion was agreed upon:—

" That it was desirable that in the imposition of a Cotton Tax the principle of a graduated tax having regard to the market price of cotton, should be adopted."

CHAPTER VII.

GRADING OF LINT.

(This item was dealt with by Cotton and Agricultural Sections jointly.)

Mr. HOLM said a very good system of grading lint had been instituted in South Africa; he thought the system of grading adopted there might be of interest to the Conference.

Mr. KOCH stated that the grading regulations in force in South Africa were as follows:—

1. All ginners of cotton shall register their names, addresses, and distinctive marks with the Chief, Tobacco and Cotton Division, Department of Agriculture, by whom the ginner shall be informed of such registration.

2. All seed cotton from which cotton lint for export is ginned shall be first graded by an officer appointed for the purpose; provided that it shall be competent for the Chief, Tobacco and Cotton Division, to dispense with such grading in such cases in which it may seem desirable so to do.

3. All cotton lint intended for export oversea shall be contained in bales the outside measurement of which shall be 54 inches by 27 inches by 20 inches. The weight of such bales shall be approximately 500 lbs., and the cotton lint therein contained shall be pressed to a density of approximately 30 lbs. per cubic foot; provided that this regulation shall not apply in respect of cotton lint which has been baled by plant actually installed in the Union prior to the date upon which these regulations came into force.

4. Each bale of cotton lint shall be clearly marked on one side thereof with a stencilled mark showing:—

(a) the registered mark of the ginner;
(b) the type mark assigned thereto by the grader;
(c) the number of the bale.

5. All consignments of cotton lint shall be accompanied by a certificate from the grader, which certificate shall enumerate each bale, and shall show the registered mark of the ginner and the type mark assigned to such bale by the grader.

6. No grading certificate shall be issued in respect of any consignment of cotton lint unless a sample from each bale shall first have been submitted to the grader.

Such samples shall be taken in the following manner:—

One portion from the cotton lint filling the bottom of the press-box, another portion when the press-box is half full, and a third from the top layers of the press-box. The three portions together should weigh about one-half pound, and must be laid one on top of the other and wrapped tightly in a sheet of paper; each sample must be marked with the same mark and number as the bale which it represents: provided, however, that it shall be competent for the Chief, Tobacco and Cotton Division, in his discretion to substitute other methods of taking samples in cases in which he deems it desirable so to do.

7. Every commercial ginnery shall apply in due and sufficient time for the presence of the grader to grade the seed cotton, and shall not gin any seed cotton which has not been graded; provided that it shall be competent for the Chief, Tobacco and Cotton Division, to dispense with such grading in all cases in which it may seem desirable so to do.

8. All seed cotton which has been graded by a Government grader shall be ginned and baled strictly in accordance with the instructions issued by the grader in respect thereof.

9. For each bale of cotton lint graded by the grader the ginner shall pay at the rate of 1s. per bale.

10. Applications for grading certificates must in each case be accompanied by a remittance of the prescribed grading fee in respect of each bale covered by such application, together with a remittance in payment of the special levy for the weight of cotton lint concerned.

(Regulation 642 of 16th April, 1923.)

There were two highly experienced graders who did the work. The samples taken according to the regulations were sent to them for grading. The grade mark was sent to the ginner. The sample was divided into two, one of which was filled and the other was available for the buyers who bought on this sample, thus preventing any cutting of the bale to obtain samples. If the final buyer overseas was not satisfied that the sample was a true one of the bale, a sample was taken on affidavit and sent to the grader who compared it with the original sample. If any difference in quality was found to exist the ginner might be requested to make good the difference in value. No serious complaints had been received yet regarding the grading. Seed cotton was no longer graded before ginning as indicated in the regulations. Classifiers have been appointed to regulate the mixing of seed cotton so as to secure uniformity.

Mr. MILLIGAN said from the grower's point of view the system was an advantage in that it gave him an independent opinion of the grade of his product and at the same time he was able to make a fair estimate of the price he might expect for his cotton.

Mr. SIMPSON considered Mr. Koch's statement of great interest. Cotton grading had not developed far in Uganda; the grower generally separated his cotton into two or three classes himself. Most of the ginners had no experience of cotton before, which made the subject of grading difficult. The buyers in Liverpool would always buy on their own sampling, disregarding any previous grading marks. Experienced graders were scarce and therefore commanded high salaries—too high for a department to pay. The development of grading in Uganda must be along the lines adopted in America and Egypt. It was hoped to establish a branch of the Liverpool Cotton Association in Uganda. All contracts of sale would be registered and have an arbitration clause to cover disputes. All the bales would be marked so that each bale could be traced back to the ginner. In addition there was much selling of cotton to large buyers in Uganda from the ginners who abrogate all responsibility at the conclusion of the sale.

In the course of discussion it was pointed out that South African cotton was not sold on the grade mark but on the sample submitted to the grader. Against this system must be placed the possibility of false sampling and the difficulty of obtaining true samples. It was demonstrated that in Uganda it was impossible to apply the South African system of grading.

A question by Mr. Cameron regarding the possibiity of the grader's certificate being used as a negotiable document as in the case of maize, gave rise to a discussion, in which it was pointed out that the sale of a product such as cotton, having many grades of different value, must be more complicated than the sale of a commodity like maize. There were so many legal points involved that it was impossible for such certificates to be used as negotiable documents.

CHAPTER VIII.

SUMMARY OF CONCLUSIONS IN COTTON SECTION.

1. Technique of Field Experiments.

That whatever method of field experiment was used it should be so designed as to permit the degree of accuracy being determined.

Attention was also called to the inaccuracy which may be involved in comparing varieties which are different in habit and which may, therefore, be differently affected by the cultural conditions adopted, *e.g.*, uniformity of spacing for large and small types is obviously unsound.

2. The Keeping and Utilisation of Records.

That the keeping and utilisation of records with regard to the Cotton plant and its yield necessitates Experimental Stations being adequately equipped.

3. The Position with regard to Cross Breeding.

That crossing ought to be valuable, but in practice it does not appear to be so. If crossing is to be of value, an early start should be made, since a long time elapses before any results are achieved.

4. The Treatment of Seed before Sowing.

That the Sulphuric Acid treatment for seed for de-linting should be fully investigated by some central institute, if local investigation proved insufficient.

5. Mass Methods for Maintaining and Improving the Quality of Cotton in the Districts.

That mass selection must be only a temporary measure during the time necessary to establish pure strains.

6. Interchange of Strains between African Countries.

(a) That the Empire Cotton Growing Corporation be asked to prepare and publish, and keep up-to-date, a list of all varieties and strains of cotton in cultivation throughout the world, with a description of the characteristics of each variety, and the conditions under which it is grown.

(b) That with a view to guarding against the disappearance of any particular strain, showing specialised qualities, such should be stored locally against possible requirements.

(c) That a uniformity of nomenclature of strains in Africa is advisable; so far as South and East Africa are concerned, it was considered that new productions should be distinguished by the name of the producing station, followed by a distinguishing number or letter, or both.

7. Introduction of new varieties from Countries outside Africa.

(a) That much benefit would accrue from the broadening of the basis of selection by the introduction of promising varieties from outside, especially from America.

(b) That the Empire Cotton Growing Corporation be asked to assist Plant Breeders in obtaining such varieties as they may require.

8. Methods of Testing New and Improved Strains of Cotton in different parts of the Country.

That it is useless to arrange for tests and records unless these are accurately carried out; any such tests should be carried out under the supervision of the Agricultural Department. Inspections, with notes, should be made as frequently as possible, and, in any case, at intervals not greater than one month; regular periodic pickings should also be made, if possible. Where sufficiently competent men are in charge, meteorological records should also be kept.

9. Cotton Tax.

That it is desirable that, in the imposition of a Cotton Tax, the principle of a graduated tax, having regard to the market price of Cotton, be adopted.

ENCLOSURE TO PART III. COTTON.

MINUTES OF COTTON SECTION FOR AUGUST 18th, 19th & 25th

THE CHAIRMAN (Mr. Milligan), in opening the Section, stated that the main object was to offer to co-workers on agricultural problems in Africa an opportunity of meeting each other and deriving the acknowledged benefit from consultation and discussion which such occasions offer. In order to make the best of this opportunity, it seemed advisable to be as informal as possible: formality generally had the effect of suppressing discussion and encouraging debate which he was sure no one desired.

He had thought it desirable to divide the subject into headings, not only from the obvious point of view of method, but in order to give the General Conference an opportunity of knowing what was going on at any particular sitting. Joint sittings with the other Sections would be arranged later on; in the meanwhile, matters concerning the technique of the subject would be disposed of.

To-day's subject was Plant Breeding and Seed Distribution, the one following naturally from the other. He had no wish to take up the time of the Conference, but would like to say that after a life-time spent in Agriculture in the Old Country and India (and latterly in South Africa) he found himself a more convinced believer in the value of plant work as time went on. The first thing, after all, in dealing with crops was to find varieties and strains to fit varying conditions; if these could not be found, then the growing of the particular crop must be abandoned. You could not go against nature without paying for it; on the other hand, by going with nature, not only could normal yields be increased, but the effects of adverse conditions such as drought, disease, and insect pests could be mitigated to no small extent.

The Conference was greatly obliged to those who had kindly submitted papers for discussion. It was obvious, however, that so far as the day's proceedings were concerned, they were too few in number to form a real basis for discussion and he asked the meeting for additional suggestions as to subjects connected with plant breeding in which members were specially interested.

A detailed discussion then arose on the best way in which the various items connected with plant breeding could be grouped. The Agenda proposed for the full Conference was examined and it was considered that the following items should be discussed in connection with plant breeding and seed distribution. (See Agenda, Category III. Cotton.)

1. Seed Improvement:

   (a) Methods of testing new or improved strains of Cotton in different parts of the country.

   (Paper by H. C. Sampson, Empire Cotton Growing Corporation. T.C.(C.)Cot.4.)*

   (b) Methods of investigating possibilities of new varieties of Cotton.

   (Paper by H. C. Sampson, Empire Cotton Growing Corporation. T.C.(C)Cot.5.)*

* These papers are reproduced in the Appendix.

(c) Selection: (i.) plant to row; (ii.) mass.
(d) Methods adopted for rapid increase of seed supply from small samples.
(e) Value of accurate observations as regards growth curves, flowering curves and bolling curves; value of correlating above curves with meteorological returns; presentation and analysis of results.
(f) Value of crossing.
(To be raised by Agricultural Department, Uganda.)

2. Methods adopted to secure the purity of seed distributed for sowing purposes.
(Paper by H. C. Sampson, Empire Cotton Growing Corporation. T.C.(C)Cot.6.)*

4. Interchange of varieties and pureness of strain of Cotton for trial and observation in various African Territories.
(Paper by the Agricultural Department, Southern Rhodesia.)

6. Yield improvement by means of field experiments.
(To be raised by the Agricultural Department, Uganda.)"

The notes on these items which had been prepared by Mr. H. C. Sampson of the Empire Cotton Growing Corporation and which had already been circulated (see Appendix) were considered and after certain subsidiary matters had been brought forward it was agreed to discuss the subjects of plant breeding and seed distribution under the following headings:—

1. The keeping and correlation of records, including the clerical side of the work.
2. Nomenclature of new strains.
3. General technique at plant breeding stations.
4. Selfing methods.
5. The position with regard to crossing.
6. The exchange of strains between different territories.
7. Methods of planting for economical multiplication of seed for small plots, by hand; and for larger areas, by methods other than by hand.
8. Mass methods for maintaining quality of cotton seed.
9. Seed distribution.

When these subjects had been disposed of it was agreed that the other items on the Agenda should be taken.

1. The Keeping and Correlation of Field Records.

Mr. DUCKER, who introduced the subject, considered that the correlation of records was extremely important, especially in territories such as Nyasaland where the variations of seasons were great. In a few years, reliable information could be obtained regarding the growth, flowering and fruiting of the plant, the incidence of insect attacks, etc. The influence of climatic conditions on these various matters might then become apparent. Up to date he had only been able to start records in a small way, but he wished to extend the system and obtain continuous and exact observations. One of the main handicaps was the shortage of native staff. He was now collecting records of plants at two stations, one at the height of about 2,100 feet, the other at the height of about 150 feet above sea level.

* This paper is reproduced in the appendix.

this latter being the altitude of the main area for cotton in Nyasaland. The climates of these two stations differed greatly ss regards heat intensity and he expected to find some difference in the correlated results. So far he had only had experience during one season and that at one station; the work was really only just being started. The observations taken were the growth of the plant from the ground, measured weekly; its flowering, measured daily; losses attributed to pests, measured daily; boll weight, etc. He was endeavouring to plot the results in curves.

So far he had seen no natural shedding. Losses were due in the main to boll worm; in Nyasaland other forms of shedding were entirely obscured by that due to boll worm. His boll worm records were at present incomplete, but he hoped to carry out further observations during next year. He considered on present evidence there was a seasonal distribution of boll worm species in Nyasaland, although previous observations had been against this view. Tobacco was a host of American boll worm in Nyasaland. Natives found boll worm attack to be negligible between August and October and they were altering their planting date accordingly.

A complication in Nyasaland was the attack of the American boll worm, following that of the Sudan boll worm. Isolated records were of very little use unless combined with agricultural records. It appeared to him necessary that correlation should start with the lay-out of experimental stations and that plant development, agricultural, entomological, and meteorological records should all be got together on the same basis. For the present season he was working out his records on seven day means.

THE CHAIRMAN (Mr. Milligan) remarked on the difficulty of getting information of real value regarding the rainfall; totals and averages were of course always available, but the more important details were wanting.

Mr. PARNELL considered that the records of maximum and minimum temperatures were not of such value as might be expected, owing to the rapidity with which temperatures changed. What would be really valuable would be a thermograph record from which could be seen the amount of time during which the temperature was above or below a certain point.

At this point the class of instruments required for records was discussed and the various members of the Section expressed their views on the types they themselves were using.

Mr. PEREIRA said that at the present stage there were not many well equipped stations in Portuguese East Africa.

Mr. CAMERON considered that wind records correlated with rainfall would be valuable, anyhow in South Rhodesia, although he agreed that wind records in many countries would probably not be of much value.

As regards the question of records in the field, the Section desired to emphasise the importance of correlating plant records and meteorological data and considered it desirable to draw up a statement showing the minimum requirements in instruments for individual stations.

Messrs. Ducker and Nye were asked to draw up a list of:—

(a) The minimum requirements for a cotton station.

(b) Additional useful apparatus.

Subsequently a paper on the meteorological instruments required for Cotton Stations was submitted by Messrs. Nye and Ducker: this was discussed by the section, and the following was approved.

Meteorological Instruments for Cotton Stations.

The list given below refers to instruments considered essential for Stations under direct European control. A few instruments are mentioned as useful but not essential, and their acquisition will be a matter whether or no, funds are available, and whether the Staff of the Station is strong enough to use them.

Soil Moisture, though not strictly speaking a meteorological consideration, is closely bound up with such phenomena as Rainfall and Temperature, and is considered as a suitable subject for inclusion under the above heading:—

The following instruments are considered necessary.	Attention is called to the following instruments, which may be found necessary in certain circumstances.
Rain Gauge.	Automatic Raingauge.
Hygrograph*	Anemometer (Anemograph).
Thermograph*	
Wet and Dry Bulb Thermometers	Barometer (Barograph).
Evaporimeter.	
Maximum and Minimum Thermometers.	Minimum Thermometer for determining terrestrial radiation.
Soil Thermometers.	Auger, Dishes, Drying Bath, and Balance for determination of soil moisture.
Stevenson Thermometer Screen.	Black & White Bulb thermometers.
Sunshine Recorder (Campbell-Stokes or Jordans).	

* These two may be combined as a Thermo-Hydrograph.

It is considered important that all instruments be of the best quality and be obtained from a reliable and well-known firm of makers. All thermometers should be tested and all records should be kept in a standardised form.

As far as British Possessions are concerned it is suggested that records be kept as follows:—

Rainfall	recorded in inches and decimals.
Humidity and Soil Moisture ...	recorded in percentages.
Evaporation	recorded as quantity per unit area per diem.
Temperatures	recorded in degrees Fahrenheit.
Sunshine	recorded in hours and minutes per diem.

As a manual for guidance in the use of the instruments recommended it is suggested that all observers should make use of the Royal Meteorological Society's publication entitled "Hints to Meteorological Observers."

Mr. NYE with regard to growth records, said he would like to know the method adopted in other places; in Uganda, if the plant was measured from the ground, difficulties invariably arose from wash after heavy rain.

The question of measurement of plants was discussed in detail.

Clerical Side of Keeping Records.

Mr. DUCKER said that he could only keep a few records of strains not retained, owing to the labour involved.

The Section was generally of opinion

That it was impossible to keep records of all strains and that it would be possible only to keep records of strains retained.

2. Nomenclature of New Strains.

Mr. DUCKER said that in Nyasaland each strain was given a letter and sub-strains were differentiated by numbers. All strains adopted in Nyasaland were commercial varieties which had been imported.

Mr. NYE said that in Uganda a number was used for the strain and another number for the sub-strain.

THE CHAIRMAN (Mr. Milligan) considered that possibly the best way of nomenclature might be to use the name of the station for all strains, followed by a number.

After some discussion on this question, the Section agreed

That the best method of nomenclature would be to designate strains by the names of the stations at which they were produced, in some cases with the addition of letters, each individual strain being differentiated by a number. They further drew attention to the fact that the registration of the stations and numbers adopted would be desirable.

3. General Technique at Plant Breeding Stations.

Mr. CAMERON asked for information on the general procedure at other plant breeding stations as regards testing of yields. The size of plot he used for variety trials was one-twentieth of an acre. New strains were grown under observation and these were then expanded into variety trials; plant diagrams were made on each variety. A large number of replications appeared to be necessary to obtain accurate results.

Mr. NYE said that in Uganda he used square plots of one-twentieth of an acre and replicated five times.

Mr. WOOD suggested 12 x 20 as a good size; he used four plots.

Mr. DUCKER said he divided his variety work into two sections:

(a) Observation.
(b) Field experiments laid out on the Latin square principle.

He used the same number of replicates as the number of variants. The main endeavour was to get down to as few strains as possible.

Mr. CAMERON asked what degree of accuracy was found by this method.

Mr. PARNELL said so far no accurate trials had been necessary in his work, as, in its present stage, he had to a large extent to rely on observations and judgment. He further stated that in South Africa a series of tests had been conducted over the Union; five varieties were grown by farmers under the supervision of a local officer; plots of four rows, 75 yards and upwards, replicated four times.

Mr. NYE said that in his field trials he used six different strains of a Nyasaland type; these were first grown in observation rows and then in yield trial plots; yield was given as per plant, or per 100 plants.

Mr. CAMERON said that when he got new varieties he grew them on observation trial plots, alternating with a standard variety.

Mr. PARNELL said his trials were intended to show how far varieties were suitable for different localities; there need be no accurate comparison of commercial varieties on his breeding station as none of the present varieties would survive after suitable strains were found.

The Section decided

That the main point was that whatever method was used it should be so designed as to permit the degree of accuracy being determined.

(Notes on Cotton Breeding work in Nyasaland, Uganda, Southern Rhodesia, Portuguese East Africa, and Swaziland were prepared by Messrs. Ducker, Nye, Cameron, Senhor Grillo, and Mr. Wood. These notes are reproduced at the end of these minutes.)

4. Selfing Methods.

Mr. WOOD said that in Tanganyika he practised stitching, using a gang of 50 boys to do the work; he selfed all the flowers in the progeny rows.

Mr. PARNELL said that he stitched his flowers; some damage was done to the plants during the process through treading.

Mr. DUCKER said he had used the stitching method, but found that the plants reacted unfavourably to the handling; also this method appeared to allow free scope to boll worm, which was important in Nyasaland. The boll worm appeared to like to enter into the stitched flower. A method had to be devised to ensure selfing and to protect the young boll. He described a type of cover made of gauze 7 ins. x 7 ins. held together by a rubber ring; this was found satisfactory and inexpensive. When the gauze was treated with beech creosote it was insect repellant as well as a preservative. The gauze costs about 10d. per yard.

Mr. WOOD asked what was the length of time the gauze was left on the plant.

Mr. DUCKER replied that this depended on experience, but they were usually left on for four or five days. Different coloured gauzes might possibly be used.

Mr. KOCH said that paper was used successfully in South Africa for tobacco and copper wire for cotton.

Mr. NYE said that in Uganda sisal fibre was used for tying; the tips were tied every morning.

Mr. DUCKER asked at what stage in the work one would stop selfing.

Mr. WOOD said that he selfed all plants from one individual selection; he asked how often the collection of lint from selection was made.

Mr. NYE said that he collected the lint every five days; each boll was picked separately and put in an envelope and the weight of lint and weight of seed per boll per plant taken in each progeny row; he selected 15 plants so as to estimate uniformity.

Mr. DUCKER said that he harvested every plant separately and took the lint and seed characteristics.

Mr. WOOD asked the opinion of the Section on the possibility of adopting a standard method of sampling and measuring by which the purity of a strain could be expressed numerically.

Mr. PARNELL said that the limiting factor with him was jassid resistence and the necessity for a resistant strain was so great that he was propagating one for distribution, which, although by no means uniform, was decidedly better than any other obtainable. This would immediately be followed by a more uniform type. He selected 12 plants from every row, whereas Mr. Ducker used every plant and Mr. Nye 15 plants from each progeny row.

Mr. DUCKER considered that periodic pickings from the progeny rows were of little value, but Mr. Parnell considered that this did show up differences.

Mr. NYE wanted to know if a standard size of plot for variety trials could be adopted.

Mr. PARNELL considered that we had not yet sufficient experience.

Mr. CAMERON suggested that rows were just as suitable as plots and were much easier to handle.

Mr. NYE said that in Uganda he used rows inside the plots; the edge effect was two plants deep.

After some discussion

It was decided to call attention to the possibility of inaccuracy in comparing strains.

Mr. PARNELL, as a result of the discussion, asked whether anyone had experience as to whether in comparing strains the spacing methods adopted were likely to affect comparative results—two feet was his standard.

Mr. DUCKER replied that he had only made casual observations on this point, but it had been noticed that one particular strain was intolerant of wide spacing.

5. The Position with Regard to Crossing.

Mr. NYE asked for information regarding crossing; he found it very difficult to get results.

Mr. PARNELL said that crossing ought to be valuable, but in practice it did not appear to be so. At present he was crossing Cambodia with another type in order to combine jassid resistance with other desirable qualities, but it appeared as if this would be obtained by selection. Selection is obviously the first thing, and if crossing is going to be of any value an early start should be made at it, for it takes a long time before any results are achieved.

Other members of the Section expressed their views on this question, the general opinion being that, although no very valuable results had yet been obtained from crossing, this was probably due to the magnitude of the work necessary in bringing it to a successful conclusion.

6. Exchange of Strains Between Different Territories.

Mr. KOCH thought it would be very useful if the Agricultural Departments of the African Territories could keep in touch with each other as regards new strains, so that when any good strain was

obtained, it might be sent round to all other territories to be tried out. He thought a resolution to this effect might be of value. On his return to South Africa he himself proposed to send samples of, say, up to 10 lbs. to the different representatives attending the Conference for experimental purposes.

THE CHAIRMAN (Mr. Milligan) thought it would possibly be better that such seed should be sent round on request. If a new type were produced, information could be circulated with regard to it to the various Governments, or, possibly, through the East African Journal, if the proposal materialised, giving its special characteristics, so that everybody concerned would have the necessary information and, if he desired to give it a trial, he would know where to apply. There was another point, there was a danger of a new strain being scrapped, because no one happened to want it at the time, while, at a later date, such a strain might be useful. Such strains, however, could be stored in sealed vessels. As the cotton industry developed possibly a special station for keeping special strains alive might come into being.

It was agreed

That the Empire Cotton Growing Corporation be asked to prepare and publish a list, which should be kept up to date by the issue of supplements, of all varieties and strains of cotton in cultivation throughout the world, with a description of the characteristics of each variety and the conditions under which it was grown.

It was recommended that cotton breeders in their reports should give details of such strains as they were themselves rejecting, but which, owing to special characteristics, might be of value to others; small stocks of such seed should be stored locally against further requirements.

7. Methods of Planting for Economical Multiplication of Seed.

Mr. PARNELL raised the question of planting small plots by hand and asked for information and the results of other workers. He had tried dibbling single seeds in a hole 1 in. to 1½ ins. and filling the hole up with sand, but was now planting in the ordinary way with a handful of kraal manure on the top; the latter prevents the formation of crust.

Mr. CAMERON said he was at present experimenting with several varieties of beans, in order to ascertain which variety will germinate at the same time as the cotton. He said he would communicate the results.

Mr. NYE had also tried planting with beans, but had not got increased germination.

Mr. PARNELL said that a farmer in the Barberton area, in order to assist in the propagation of a jassid resisting strain, offered to use the single seed method, along with manure, on a field of 50 acres (this works out at 3lbs. per acre at 1 foot apart and 3 ft. 6ins. between the rows). Turning then to the question of the planting of large areas thinly, he said that he knew of no machine which was able to do this properly. In order to obviate the labour difficulty it was desirable to find a drill capable of dropping seeds two or three at a time at any spacing up to two feet.

Mr. DUCKER said that he had a design of a machine coming out from U.S.A. and as soon as he had these designs he would circulate information to the other members of the Section.

Mr. CAMERON also promised to report on a machine he had heard of in Rhodesia.

The Section considered that it would be useful to have information of such machines and mutually undertook to circulate information should any fall into their hands.

8. Treatment of Seed before Sowing.

Mr. CAMERON said that at Gatooma in Rhodesia seed was treated with sulphuric acid; a 5-gal. drum was used and from this four sections were cut down, so that only a skeleton was left; this was lined with steel mesh $\frac{1}{8}$th of an inch thick and on top heavy lead plates. The whole was put into a larger drum containing sulphuric acid, it remained for five minutes and was then washed five successive times in water; this cost about 5d. a lb., but could be done for 2d. if large quantities of sulphuric acid were bought. Suphuric was used three times and about 30 lbs. of seed done at one time. This method also served to screen the seed. He had found that too much lint left on the seed damaged the planter, so that for seed purposes a de-linter had to be used; de-linting facilitated planting, but did not give any better germination; the sulphuric acid helped to reduce to the consistency of treacle any bad, weak seed.

Mr. NYE had tried sulphuric acid treatment and found that the longer in the acid, the higher the germination. He tried immersing in sulphuric at 5, 10, 15, and 20 minutes; in some cases the seed was split; even then germination was not affected. The table below shows the results observed:—

Treatment.	Germination percentage.	No. of days to complete germination.
Control No. 1:		
No treatment	63.5 ...	10
Control No. 2:		
Water soaked 10 minutes	55 ...	9
H2 SO4 5 mins.	76 ...	4
H2 SO4 10 mins.	81 ...	4
H2 SO4 15 mins.	83.5 ...	6
H2 SO4 20 mins.	96 ...	4

A subsidiary test on the germination of seeds floating on the surface of the acid showed low germination:—

5 mins.	32%	germinated
10 mins.	33%	,,
15 mins.	50%	,,
20 mins.	76%	,,

Mr. DUCKER found that a large percentage of the border line seed was killed by the acid and that the germination of untreated seed was better.

Mr. PARNELL suggested that any investigations should carry a crop right through, as it had been found that in the case of some other crops, where seed had been treated, the germination was good, but the subsequent growth of the crop was affected.

The CHAIRMAN (Mr. Milligan) stated that he thought the question one of sufficient importance to ask some institute, such as the Cotton Research Station at Trinidad, to investigate it in all its aspects, if local investigations which various members said they would undertake proved insuffiient.

The Section generally approved of this suggestion.

8. Mass Methods for Maintaining the Quality of Cotton Seed.

Mr. KIRBY (Director of Agriculture, Tanganyika) attended for this item and made a prepared statement to the Section, as follows:—

By the quality of cotton seed is meant here its capacity to produce good cotton.

Mass selection in plantations is carried out by going through the plots and marking the plants of type and (roughly) cotton quality required, and using these as sources of seed, the process being repeated in each season.

Mass selection in districts is effected by choosing for supplying seed the plants on farms or parts of farms that show good and successful characters where no advantage as far as can be ascertained accrues through exceptionally favourable environment. Arrangements are made for the acquisition of the seed, which is distributed specially, under control and under guarantee from trustworthy recipients, who in increasing numbers grow succeeding crops from it under particular arrangements for acquiring the resulting seed-cotton. Parallel to this, the work described in the first part of this paragraph is continued in every season.

Another method is similar to the last described; but it consists in acquiring from a (neighbouring) country or district in the country itself seed, in large quantity, that comes from an area or areas in which the quality is known to be good, and taking similar care to grow it apart from all other seed and to avoid mixing as regards the seed produced. This is mass introduction, rather than mass selection, and requires care to ensure that: (1) the growing conditions in the receiving country are sufficiently similar to those of the country of origin to make it likely that there will be no general failure through introduction into unsuitable conditions; (2) no risk is taken of the introduction of insect pests.

The last method in mind is direct mass selection of the seed. Enquiry has shown that in Upland (and Egyptian) cotton the best lint comes from the fuzzy seeds, not from the partly covered or nearly naked seeds; and that fuzziness is recessive to nakedness (see *Agl. Journ., India*, XX, 1925, 37). Thus in practice (actually in Egypt) manual or mechanical removal of seeds that are not fuzzy should leave a suppy of seed capable of producing lint better than that from the general. Ordinary hand-picking, by women and children, is slow for the purpose; and is (it is understood) hastened for output in Egypt by passing the seed along the row of hand-pickers on an endless belt travelling at a suitable speed. A mechanical means for effecting the separation would be valuable.

These and other methods of mass selection are not of course a substitute for narrower methods of selection (progeny rows, etc.) or for cotton-breeding. They are useful for supplementing the latter, especially where haste is thought to be required, and in the early

stages of a cotton industry not yet receiving the labours of technical specialists: and it is considered that description and discussion of them and their results will serve a useful purpose.

(This statement was circulated to the Conference as T.C.(C)Cot.9)

Mr. KIRBY, continuing, said that his statement referred particularly to the native Cotton industry only and had been prepared with a view to summarising matters for discussion.

In the discussion which ensued the view was generally held that the Director of Agriculture, Tanganyika, had at present no alternative to mass selection. The method of selection of seed on appearance, as described in Mr. Kirby's paper, depended on whether the fuzziness of the seed in the mixture dealt with was really associated with good quality lint. This was a matter for investigation and could not be accepted without actual trials. The experience of most members of the Section was that no linkage existed between fuzziness and good quality lint.

Mr. CAMERON said that the situation in Southern Rhodesia in regard to seed was unsatisfactory. Two years ago the country was inundated with all kinds of seeds and many of these had given poor results. This year the administrative authorities had advertised the fact that they wanted to help growers to get good seed and that farmers who considered they had a good crop of cotton from which seed could be obtained for the next year should notify the authorities. Some 70 or 80 did so and officials were detailed to inspect the fields of those growers. Out of the number 25 were accepted. Those selected were asked to pick pure white cotton and see it ginned themselves. This seed when finally approved at the ginnery was bagged and sealed under official supervision. Owing to the bad season, however, the result had been disappointing and they had not been able to get sufficient of the best quality seed. Next season's seed would be that which had been obtained from crops which had yielded fairly well in a bad year and the farmers would get their own seed back, since it had been put in specially sealed bags. All this inspection work had been very heavy, but two men had been able to inspect sufficient for 20,000 acres. If successful this year, then it was proposed to go on with the system. The farmers had guaranteed to pay fair prices for seed with a guarantee of germination. In Southern Rhodesia it was very difficult to distinguish between the various reputed varieties.

Mr. SALTER said that in Northern Rhodesia the same state of affairs prevailed and they were being forced to adopt similar methods.

Mr. NYE said that in Uganda he did not think that any mass selection had been tried.

Mr. KIRBY said that in Tanganyika the ginnery work was based on the fact that the authorities had powers of requisitioning seed: they accordingly took seed from the first cotton ginned, thus obtaining the cleanest cotton seed and so working towards a more early maturing cotton. A certain success had been obtained and reports showed no deterioration in Tanganyika cotton.

Mr. PARNELL considered that it might be better when seed had once been passed to carry on with it in future years, even if the yield in one particular year was not very good; this seemed to him to be possibly a better arrangement than going round each year selecting seed from crops giving a heavier yield.

Mr. CAMERON thought that as regards Southern Rhodesia this would necessarily prove the case in a very short time, as only very few farmers grew cotton which was of a sufficiently high standard to pass an inspection. If there were a good year next year there would be sufficient good seed obtainable.

Mr. KIRBY thought it was better to make use of properly acclimatised seed rather than to bring in seed from any area where different climatic conditions existed.

9. Seed Distribution.

The CHAIRMAN (Mr. Milligan) opened the discussion by remarking that in countries where there were European cotton farmers there was no difficulty in being able to multipy the supply of new seed, but in native areas it was an entirely different matter; the only solution that he could see for these areas was the establishment of seed farms as the first step for multiplication.

Mr. DUCKER said that in Nyasaland there were certain large native areas and other smaller isolated areas; the idea was to use the smaller areas as stepping stones from pure strain stocks at the stations or elsewhere to the general crop of the country.

Mr. WOOD said that in Tanganyika there were no isolated areas of that sort which could be used.

Mr. KOCH said that in South Africa if a strain was considered suitable, about 100 acres of it was grown at an experimental farm; the seed from that was distributed to about a dozen progressive European growers in suitable areas; these growers have to sign an agreement. (Copy of the agreement is included in the Appendix.)

Mr. NYE remarked that in Uganda there were no European cotton farmers and there were not sufficient seed farms to be able to multiply the seed to supply the whole country; as much as possible was produced at the experimental station and this seed was distributed to two or three chiefs who grew this away from all other cotton. The danger was that they had to rely on the ginnery to keep the seed separate. After this one area, served by one ginnery, was selected, the seed was requisitioned and gradually the area was enlarged until finally the whole district was supplied.

Mr. WOOD expressed the opinion which he supported from his own experience that the best way to ensure the economical distribution of a valuable strain was to sell it at a price markedly above the ordinary market price.

Mr. CAMERON strongly supported the view and suggested that seed should be made up in 10 lbs. and 20 lbs. packets and sold at about 1/- a lb., so that an issue of small packets could be made to a large number of farmers.

Mr. PARNELL said this method had been tried, but experience showed that eventually seed issued in small quantities was lost; he considered that concentration was a better method. The small packet method was much too dangerous, as it was liable to get mixed in ginning.

The CHAIRMAN (Mr. Milligan) said that taking the multiplication rate as 15 times to supply, say, 60,000 acres meant putting out blocks

ggregating 4,000 acres. It was a matter for individual opinion, but e had seen the bad effects of mixing and considered the small packet nethod dangerous.

Mr. PARNELL said that the method he proposed to use was to ive several growers fairly large quantities of seed; in the first year a ertain amount of mixing is unavoidable, but when the grower gets his vhole crop under the new seed and a further supply of pure seed is iven to him, a washing out process would take place with a rogressive improvement as regards purity.

The Section had no definite suggestion to make as to the method of seed distribution and considered that each country would settle the question in the way best suited to itself.

10. Measurement of Lint at Cotton Breeding Stations.

Mr. WOOD opened the subject by describing his method of measuring lint. He combed out one side and measured from the edge of the seed to the edge of the halo.

Mr. PARNELL said that he combed out both sides of the seed and measured the average length for the whole seed as nearly as possible. The actual measurement was made from the parting to a point, short of the extreme edge of the halo, where the bulk of the hairs terminate.

Mr. NYE said that he combed out one side and pulled out a tuft at about three o'clock, and then put it on paper for measurement. He considered it was very important that everyone should measure in the same way.

The CHAIRMAN (Mr. Milligan) said that, in view of the facility now offered in England for examination and spinning tests of cotton, the main thing was that the Plant Breeders' own comparisons should be accurate.

This led to a discussion with regard to spinning tests, in which the desirability of receiving early reports was emphasized, in order to obtain the information before the ensuing cotton planting season.

11. Introduction of Seed from Countries outside Africa.

Reference was made to the Note by Mr. Sampson on "Methods of investigating the possibilities of new varieties of Cotton," and a general discussion on the subject took place. (This Note was circulated under No. T.C.(C)Cot.5 and is reproduced in the appendix.)

Mr. CAMERON drew attention to the shortage of material for selection, and the necessity for some central organisation such as the Empire Cotton Growing Corporation, acting as a collecting and distributing agency.

Mr. WOOD stated that there was a danger of over-emphasizing this aspect; he considered selection from what stock was already in the country of more importance.

The Section generally approved Mr. Cameron's suggestion, and further wished to propose that disinfecting might be done in London. It was agreed that the Empire Cotton Growing Corporation should be invited to assist Plant Breeders to obtain such varieties as they required.

12. A Promising Species of Wild Cotton in Mozambique.

BARON SURCOUF, of the Mozambique Company's Territory, joined the Section for this item and made a statement as follows:—

In the course of my researches in the Southern parts of the territory of the Mozambique Company, I have found three specimens of a wild cotton plant.

The exact localities are: the first at Chaimal near the hut of the native chief; the second at the edge of a native village; the third on the veld in the same region.

This cotton grows to a height of 2.50 m., but cannot hold itself erect for more than 1.50 m., the remainder being curved downward.

At first, I classed this plant under *Gossypium anomalum*, but it differs from it by the following botanical characters: the flowers are pale yellow without spots, the epicalyx is short, but much enlarged transversely, the boll is not very granulated, but smooth besides, the staple is nearly an inch and very strong; the seed number 18 to 20 and are free as in *G. anomalum*, but more numerous.

The region of Chaimal, rich in native rubber, is situated in the District of Mocoque. Its altitude is about 100 feet above sea level, the soil is sandy with some argillaceous material overlying cretaceous formations. There is no water.

The three specimens had grown under very unfavourable conditions and the bolls were all perfectly healthy. I found no parasites.

If this cotton is not an autochthonous species, it is possible that it originally came from India and that, little by little, through lack of cultivation, it has obtained its present characteristics.

I have brought along a few samples to show to the Conference.

(This statement was circulated to the Conference as paper T.C. (C)Cot.13.)

Subsequently, in answer to various questions put to him, he described the specimens in greater detail.

SENHOR PEREIRA asked whether there was any possibility of crossing long staple and wild cotton.

Mr. NYE remarked that he had found no species of wild cotton in Uganda, and that in his experience it was often difficult to cross two species.

Messrs. CAMERON and WOOD both stated that they had noticed types of wild cotton in Rhodesia and Swaziland.

BARON SURCOUF said he was proposing to cultivate this species of wild cotton, and would be very glad to distribute seeds he had brought with him to any members of the Section who cared to have them.

The Section thanked Baron Surcouf for his most interesting statement and said they would be very pleased to receive specimens of the seed from him and to grow the cotton at their stations. The members of the Section individually undertook to publish the results of any observations.

13. Methods of Testing New and Improved Strains of Cotton in Different parts of the Country.

The CHAIRMAN (Mr. Milligan) referred to a note by Mr. Sampson on this question (T.C.(C)Cot.4)*. He considered that the difficulties mentioned did not apply to South Africa, where the cotton growers were non-native, but probably rather to Nyasaland, Tanganyika, and Uganda; in fact, the difficulties mentioned would probably apply to all countries with native growers.

Mr. DUCKER said that for any real tests it was essential to have white men for regular supervision; so far he had been unable to conduct any large scale tests, but he aimed at working up to tests on a commercial scale.

Mr. WOOD said that in Tanganyika the conduct of tests was difficult; there were few missionaries, and the few planters there were not prepared to arrange for trials in addition to their own work. In Swaziland he had given payment for tests and this had been satisfactory. He thought that the only solution was to have Agricultural Officers of the district in charge of experimental plots.

Mr. NYE said that the problem was easier in Uganda; each district had a small plantation under the supervision of the Agricultural officer, where tests could be carried out. It was, however, impossible to arrange for records on plots all over the country; these must be taken at certain selected places.

The Section was of opinion:—

That it was no good arranging for tests and records unless these were accurately carried out; any such tests should be carried out under the supervision of the Agricultural Department. Inspections, with notes, should be made as frequently as possible, and, in any case, at intervals not greater than one month; regular periodic pickings should also be made, if possible. Where sufficiently competent men were in charge, meteorological records should also be kept.

NOTES ON COTTON BREEDING.

The section examined the question of Cotton breeding in detail and discussed the methods adopted in the various Territories. The members of the Section prepared the notes given below on the different systems used.

Nyasaland.

From a large collection of types, obtained both locally and from abroad, a number of promising strains of cotton have been retained for growing and examination in the current season, 1925-26.

These strains fall into two main groups as regards their staple lengths, the one with staples about 1 1-16th inches, the other with staples about 1 3-16th inches. It is not yet known to what extent they differ in other characteristics considered generally.

* See appendix.

The majority of these strains are in the stage of progeny rows. That is they are represented by progeny rows each obtained from a single plant selection of the preceding year. Two strains have been sown as bulks and of these one will have to be discarded on account of Jassid susceptibility.

Up to this season, 1925-26, all work has been done at the Makwapala Cotton Station which is situated at an elevation of about 2,100 feet above sea level. From and including the 1926-27 season it is proposed to dupicate the work at the Port Herald Cotton Station which lies at about 150 feet elevation. It is considered that these two stations cover the main types of climatic conditions under which cotton is grown in Nyasaland.

All plants in all progeny rows are being harvested separately each into its own bag and comparisons are being drawn between the progeny rows in respect of the evenness of their component plants as regards Lint and Seed characteristics. Judgment being used in deciding which of the progeny rows are to be examined in this fashion, susceptibility or otherwise to Jassid attack being an important factor, provided that is that the rows are even vegetatively in so far as ordinary observations go.

It is proposed to carry on the strains derived from these progeny rows in future seasons by taking for sowing as further progeny rows a number of plants which lie nearest the mean for the rows.

From and including the 1926-27 season it is hoped that it will be possible to ensure self fertilisation in the case of all plants grown in the progeny rows. The tendency, therefore, will be, as time goes on to establish nucleus stocks of strains which will become more and more homozygous with each year that they are grown.

A preliminary test will be made each season with part of the bulk seed from the progeny rows which appear to be particularly promising, using flowering and fruiting studies to decide which strains are worthy of inclusion in full field trials in the following season. The balance of the bulk seed being sown in each case in an increase plot.

Full field trials will consist of plots, sown with seed obtained from the increase plots, arranged in such a way as to give a known degree of accuracy to the results obtained. All new strains used in these trials will be tested against the ordinary field crop as a whole as well as against one another.

The most superior strain will be further bulked with a view to replacing with it the ordinary field crop as time goes on. The aim will be to retain the pure parent stock and from this obtain further supplies of seed wherewith to renew the general seed stocks as required.

Any new varieties obtained in the future will be first sown in observation plots and then selections from them will be passed to the progeny rows for purification.

(Sgd.) *H. C. Ducker.*

August, 1926.

Serere Experimental Station, Uganda.

AIMS.

At the present time breeding and selection is being done with the following aims:—

Improvement of yield.
Purity of strain.
Maintenance of a regular 1 3-16in. staple.
Maintenance of quality.
Resistance to Blackarm disease.

SELECTION.

Single plants are selected from the growing crop in native plots and from progeny rows of the previous year. From these plants progeny rows are grown and 15 plants in each row very carefully observed, the following records being taken:—

Daily flowering records.
5 day boll records.
Weekly growth measurements.

All plants are self fertilised by the tying method.

Every boll is picked separately and the following characters are recorded for each boll:—

Loculus number.
Seeds from loculus.
Weight of lint.
Weight of seeds.
Lint length.

For each plant Lint Index and Ginning outturn are worked out.

As a result of the analysis of the above observations the most promising rows are selected for growing in $\frac{1}{4}$ acre increase plots in which 100 plants are selected at random for boll records and these are taken as the mean of the plot. Lint from these plots is sent home for spinning tests and if the report is favourable the best strain is grown in a large increase plot and also grown in a yield trial with types in general cultivation. If results are satisfactory yield trials are held at various sub-stations and then the strain is grown on in bulk and eventually distributed to natives.

CROSS BREEDING.

Although the difficulty in dealing with large F3 and F4 generations is realised, a few crosses are being followed up.

Apart from selection work, the question of yield improvement is being tackled by means of field experiments, such as sowing date, spacing and method of culture.

In the case of newly introduced varieties, progeny rows are grown for several years and similar records to those mentioned above are made.

Complete meteorological data is obtained and used for correlating with observations on progeny rows.

(Sgd.) *G. W. Nye.*

August, 1926.

Government Cotton Breeding Station, Gatooma, S. Rhodesia.

In 1925, the Municipality of Gatooma leased 400 acres of commonage to the Government for the purpose of conducting experiments in cotton, the land in question being free from rent and the lease to continue so long as it is being specifically used for the above purpose.

Stumping and clearing operations were commenced in August, 1925, under the supervision of a European foreman, locally engaged. At the same time Kimberley bricks were made and Plant Breeders' quarters erected. This last, though hastily built, is fairly substantial, and should serve its purpose for at least four or five years, by which time, it is considered, cotton will either be established in the country or abandoned as an unsuitable crop.

The late commencement in making the preliminary arrangements, coupled with an unsatisfactory planting season, rendered the first year's work extremely difficult and it is just possible that too much was attempted under the circumstances.

The Station is now well estabished, however, and it is hoped to fulfil a variety of useful purposes in the immediate future.

STAFF.

Mr. Peat, the Plant Breeder in charge of the Station, is responsible for all investigational work carried out under the direction of the Empire Cotton Growing Corporation's senior representative in Southern Rhodesia. Another Plant Breeder, to assist Mr. Peat, is expected before the commencement of the approaching season in November. The technical staff are provided by the Empire Cotton Growing Corporation, while the European foreman, native labour, implements, scientific equipment, and general expenses are borne by the Government of Southern Rhodesia.

WORK UNDERTAKEN DURING 1925-26 SEASON.

An area of 40 acres was put down to Improved Bancroft. Seed from the best cotton crops in the country was used, and it was hoped that it would be possible to rogue out a large number of undesirable plants, thus giving a small quantity of improved seed for distribution the following year. As this crop had to be replanted at a very late date, however, the scheme was abandoned, owing to the unsatisfactory yield which the crop produced.

An attempt was also made to carry out comparative trials of five exotic varieties of cotton imported from the U.S.A., the local variety, reputed Improved Bancroft, being used as a standard of comparison in the trials. The exotic varieties under trial were the following:—

Acala.
Express.
Trice.
Tanguis.
Delfos.

These were grown in 1-20th acre plots and repeated four times. Owing to the haste with which all work connected with the Station had to be undertaken, it was not possible to pay due regard to obtaining an ideal scatter, in order to obviate marginal effects.

Growth, flowering, and bolling records were kept, while plant diagrams were made of a number of plants of each variety together with diagrams of other varieties which were grown in observation rows.

METEOROLOGICAL OBSERVATIONS.

Rainfall and temperature records (max. and min.) were kept from the commencement of the season, but additional records will be kept in future now that the Station is equipped with the requisite instruments such as a thermograph, barograph, wet and dry bulb thermometers, and sunshine recorder.

SCIENTIFIC EQUIPMENT.

A sum of £300 was voted for this purpose, but it was not possible to utilise it all before the end of the financial year. Sanction to carry over the grant to the following year was willingly accorded by the Treasury and it is satisfactory to record that the Station is now well equipped in this respect.

AGRICULTURAL IMPLEMENTS AND STOCK.

The implements on the Station consist of:

1 Three-furrow disc plough.
1 Set zig-zag harrows.
1 Disc harrow.
1 Cotton and mealie planter.
1 Ox wagon.
Picks, spades, mattocks, etc.

The live stock on the farm consists of two spans of trek oxen, which do all the ploughing, harrowing, carting, and general work on the station.

LABOUR.

About thirty natives are employed continuously on ploughing, cultivation, brick-making, building and general work. The stumping and clearing of the land is carried out by convict labour, as available.

BUILDING.

These are all made of Kimberley brick, with corrugated iron roofs, concrete foundations and ant-proof sheets of zinc between 4th and 5th courses. The Plant Breeders' house was the first building to be erected, and is, therefore, the worst constructed, as it had to be rushed up in a hurry prior to the rainy season. The remaining buildings were built during the following dry season. They are:—

1. Foreman's house.
2. Botanical Laboratory, with dark room.
3. Office.
4. Cotton store.
5. Insect proof iron cage, 8 ft. x 12 ft. x 20 ft.

The latter was built at an approximate cost of £40, with a view to testing the possibility of raising specially selected cotton plants in it, and to note their behaviour when grown under cage conditions. A limited number of plants from each variety of Cotton were reared in this cage, and plant diagrams made of each for comparison with diagrams made of plants from the same varieties grown under field conditions. When these diagrams have been completed, it is

anticipated that their comparison may throw some interesting light on the amount of combined damage due to boll worm, jassid and stainer attack.

PROGRAMME OF WORK FOR 1926-27.

This will not be decided upon definitely until it is known whether the additional assistant Plant Breeder will arrive from the U.K. in time to help with the lay-out and planting of next year's experiments.

The following, in brief, is an outline of the work to be undertaken, if all goes well:—

1. Meteorogolical observations and recording of same.
2. Growth in observation lines of some seventy varieties of Cotton, which, to the writer's knowledge, have not been grown in Southern Rhodesia previously:
   (a) On unmanured land; and (b) on heavily manured land, with the object of discovering a variety or selection from a variety which will give a dwarf or medium sized plant, when grown in rich soil.
3. Growth in observation lines of field selections made last season under conditions (a) and (b), as indicated above.
4. Recording usual observations and measurements on selected plants of each variety and strain, grown on the station.
5. A repetition of the variety trials conducted last year, with a view to ascertaining to what extent such trials can be relied upon.
6. A comparison of Cotton plants grown: (a) in the insect proof cage, with (b) Cotton plants of the same variety grown under field conditions.
7. Observation rows from seed of the different varieties, grown under cage conditions last year, with a view to noting whether or not any crossing has taken place.
8. " Increase " or " small bulk " plots, of what appears to be the better varieties among those which were grown in last year's variety trials. The results of these trials are not yet to hand, nor is it likely that they will give any indications when they arrive, but three out of the five varieties appeared to be much better than Improved Bancroft.

OTHER CROPS.

Maize was grown on the Cotton Breeding Station last year to avoid having to purchase food for the native labour. The resulting crop yielded so well, however, that it is proposed to sell it to local farmers, from whom there is a strong demand for seed. Potatoes, monkey nuts and vegetables all yielded good crops: it is proposed to continue growing them in rotation with Cotton.

(Sgd.) *G. S. Cameron.*

August, 1926.

Portuguese East Africa.

Cotton as a crop is still in its infancy in Portuguese East Africa; our export has not yet reached 3,000 bales.

Mr. J. A. Evans of the United States Department of Agriculture was invited to accept a temporary engagement with the Government of Portuguese East Africa, to give advice as to the lines on which the cotton industry should be conducted, and he is at the present time writing his report.

Two years ago we carried out some experiments with four varieties north of the Zambesi River, at a place located 100 miles from the coast and at 500 feet above sea level.

The relative order of merit of these varieties as shown by these trials is as follows:

	Upland. Nyasaland	Bancroft. Improved	Hybrid. Zululand	Watt's long staple.
Earliness	1	2	3	4
Type of plant	1	4	3	2
Average yield per plant	1	3	4	2
Percentage of Lint ...	—	27%	—	28%
Resistance to Angular Leaf Spot, and Anthracnose	1	2	3	4
Resistance to Jassid ...	1	3	2	4

The last-mentioned three varieties were so much inferior to Nyasaland Upland that they were abandoned and apart from the Coast Belt, Nyasaland Upland is now generally grown.

At present we have under observation some fields of Pima, imported from the Union of South Africa, located in the Coastal Belt. Other trial plots for variety tests were established at Umbelusi at the Experimental Farm last season which was carried out by Mr. Evans with seeds brought from the United States of America Department of Agriculture, but, owing to unfavourable weather conditions they have not yet reached maturity and the results cannot yet be stated.

(Sgd.) *S. Grillo.*

August, 1926.

Swaziland.

The Cotton specialist arrived in Swaziland in September, 1925, and has seen one season through. An area of some 20 acres at Bremersdorp was leased, and on this, besides the various series of experimental plots, fairly large areas of the five commonly grown varieties were planted, as well as a few small plots of introduced American varieties, all of which served as material from which selections were made. Some 130 plants were marked in the field. The characteristic to which the greatest importance was attached being resistance to the attack of Jassid. This pest appeared rather late in the season, but was considered sufficiently severe to afford a test of this quality. These are now in process of elimination and at present some 40 are still retained.

The programme for the coming season is to plant out progen plots from the plants that survive, and for this to use a small are which is known not to have grown cotton for many years. Besides this multiplication plots are being arranged, both at headquarters and a different places through the country to test one of Parnell's strain from Barberton which it is thought may be suitable for widespread distribution next year. A few other strains from Barberton, not ye available on such a scale, will be tested and multiplied a headquarters.

(Sgd.) *C. Wood.*

August, 1926.

PART IV.

Entomology & Mycology.

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PART IV.

ENTOMOLOGY AND MYCOLOGY.

CHAPTER I.

INTRODUCTORY.

The normal constitution of the Entomological and Mycological ection was as follows:—

Ir. Claude Fuller (Chairman)	Asst. Chief of Division of Entomology, Union of South Africa.
Ir. T. J. Anderson	Entomologist, Kenya.
Ir. C. B. Hardenberg	Entomologist, Portuguese E. Africa.
Ir. H. Hargreaves	Entomologist, Uganda.
Ir. T. W. Kirkpatrick	Asst. Entomologist, Kenya.
Ir. J. McDonald	Mycologist, Kenya.
Ir. A. H. Ritchie	Entomologist, Tanganyika.
Ir. C. Smee	Entomologist, Nyasaland.
Baron J. M. N. Surcouf	Entomologist, Mozambique.
Iiss E. J. Welsford	Mycologist, Zanzibar.
Ir. H. Wilkinson	Inspector of Plantations, Kenya.
Technical Secretary ...	Mr. T. J. Anderson.

The CHAIRMAN (Mr. Claude Fuller), in opening the proceedings, tated that he proposed that the items should be dealt with much as possible by informal discussion. He explained that the genda had been divided into three sections, dealing with Agriculture, otton, Entomology and Mycology, but as it was obvious that the ntomological and Mycological Section should be in a position to put rward views in regard to all items on the Agenda, which might in y way concern them, it would be advisable to go through the whole genda as it stood and to group those items on which the ntomologists and mycologists should give an opinion to the General nference.

After discussion it was agreed that the subjects should be taken n the following order:—

I. COTTON.
II. COFFEE.
III. COCONUTS.
IV. MYCOLOGICAL QUESTIONS.
V. GENERAL.
VI. LEGISLATIVE MEASURES.

CHAPTER II.

COTTON.

The record of proceedings in the Entomological and Mycological Section in regard to cotton pests has been embodied in the following report, which was submitted by the Chairman to a joint meeting of the Cotton, Entomological and Mycological Sections:—

(The full record of proceedings in the Entomological and Mycological Section in regard to cotton pests is to be found in Enclosure to Part IV.)

REPORT.

I have to inform you that the Entomology and Mycology Section has devoted a considerable amount of attention to the discussion of the many items on the agenda relating to the insect pests and diseases of cotton. With regard to the mycological troubles of the cotton plant, I regret to say that none of these have formed the subject of investigation by either of the Mycologists present.

Our deliberations have been very largely of an informal character, but in some cases we have been able to arrive at fairly definite conclusions. Where we have been able to do this, some specific recommendation or resolution has been arrived at to submit to this combined session.

With your permission I shall now review our deliberations and place the results before you so as either to facilitate or obviate further discussion.

SECTION I.

INFORMATION OF GENERAL INTEREST IN CONNECTION WITH MAJOR COTTON PESTS.

(a) A New Platyedra.

Mr. Hancock, Uganda, presented a paper* (T.C.(C)E. & M.4) upon a *Platyedra*, closely resembling the Pink Boll Worm of cotton which he discovered infesting the wild *Hibiscus diversifolius*, on the Kagera River, Uganda. Since his paper was prepared, Mr. Hancock has fortunately found himself in a position to state definitely that this is a new species. That it was different from the Pink Boll Worm was suspected from the anatomical characters of the larva. The name given to this new species is *Platyedra erebodoxa*.

Further to this, I have to state: (1) that although this new species was discovered in the vicinity of cotton, no cotton has yet been found infested by it; (2) that from the information before the Conference it seems highly improbable that this new species will attack cotton; (3) the matter of its status as a cotton pest must remain indefinite for the present.

My Section recommends that the following conclusion be adopted by the General Conference:—

> The *Platyedra erebodoxa* discovered by Mr. Hancock shows no indication of becoming a pest of Cotton in Uganda.

* For text of this paper see page 228.

) A New and Serious Boll Worm: *Argyroploce sp.*

Mr. Hargreaves related the occurrence of a new cotton boll worm Uganda which he considers a potentially seriously pest. These are s remarks upon it:

Argyroploce leucotreta, Meyr.

" It is only during the past three years that this insect has been nown as a cotton boll worm in Uganda. Our first record of this ecies was obtained in 1921, the larva being found attacking unripe aize cobs. Difficulty has been experienced in obtaining live aterial for life history determination. Pupation takes place within ie attacked boll.

" Extensive outbreaks of this boll worm have not been observed Uganda, but the insect will probably prove to be more injurious an *Earias spp.*"

In a sense, the most serious aspect of this report is that the sect has been determined as the same as the common and idespread " False Codling Moth " of South Africa.

Whilst none of the entomologists present desire to challenge this etermination deliberately, I may say that, speaking for myself, I gard it with the gravest suspicion and accept the responsibility of ecommending that the identification of this new boll worm be verified y Professor A. J. T. Janse of Pretoria and that any account of it be ithheld until this has been done.

e) The Apion Weevils.

Baron Surcouf presented a paper* covering certain observations ade by him upon the attack of the weevil *Apion armipes* upon otton plants in Portuguese East Africa.

From the discussion that arose it appears that several species of is genus have been observed attacking cotton plants in various parts Africa. So far no Apion attack has come under the notice of the otton Entomologists of South Africa (Haines). One species was ported as a serious pest in Nyasaland about the year 1909. This sect is still present in that Territory, but does not do much damage; appears late in the season and the injury is negligible (Smee).

According to Mr. Hardenberg, *Apion* seems a potential pest of ry great importance at Quilimane.

According to Mr. Ritchie *Apion xanthostylum* is found in Tangan- ika but only in the Morogoro area. The first generation attacks the se of the young cotton, and may kill the plants. Further generations eed, at the junction of the branches and under the boll, causing remature ripening and the consequent weakening and shortening of ie staple. Early in 1922 they realised that *Apion* could be a serious otential pest of cotton, and 15% of the plants on the experimental tation at Morogoro died early in the season from attack at the base. fter that time strict measures were taken to ensure that all cotton as properly uprooted. *Apion* is still found, but its effects are not garded as serious. Parasitism by a Braconid is known, but control y parasites cannot be relied upon; it has been found in Tanganyika hat uprooting and burning is an entirely satisfactory method of ealing with the pest.

* For text of this paper see page 233.

The delegates agreed that Baron Surcouf's paper should be incorporated in the Report, but that a statement should be added to the effect that:—

> There is danger of *Apion* becoming a serious pest if uprooting and burning is not resorted to, and that in Tanganyika uprooting and burning has been found to be entirely successful.

(d) The Economic Status of Cotton Stainers *(Dysdercus spp.)*.

The paper* upon these cotton pests presented by the Rhodesia Department of Agriculture was read and considered in conjunction with the notes† submitted by Mr. G. C. Haines, Union of South Africa. At the same time an endeavour was made to formulate a reply to the question raised by the Secretary for Agriculture, Union of South Africa regarding Internal Boll rot and the value of: (a) Natural enemies; (b) elimination of food plants; (c) trapping, and (d) hand collecting, in the control of stainers.

My Section is not, unfortunately, in a position to give an explicit and full answer to the question as put, but considers that some practical means of controlling the suctorial insects of cotton could be devised and points to the successful use of a sweetened arsenical solution in the control of the Antestia Bug of Coffee.

In view of the diversity of views existing among Entomologists, it was agreed that the following statement be recommended for adoption by the General Conference:

> ‡ The status of suctorial insects in the spread of boll rot requires much more investigation before any definite statements can be made. The problem is the more difficult owing to the fact that the boll rots have not yet been classified.

(e) General.

The questions of the Empire Cotton Growing Corporation regarding natural occurrence of major pests and their behaviour under conditions of cultivation were considered and the Section decided to adopt the statement formulated by Mr. G. C. Haines, Union of South Africa, and agreed that a wider survey was needed before any definite information could be supplied. Mr. Haines' statement is as follows:

"Except for the very small cotton areas in the Cape (of which little study has yet been made as to their insect pests) the boll worms *(Diparopsis castanea, Chloridea obsoleta,* and *Earias spp.)*, the cotton jassid *(Chlorita fascialis)*, the cotton aphis *(Aphis gossypii)*, the stainers *(Dysdercus spp.)*, and the cotton seed bug *(Oxycarenus sp.)* are found naturally all through our cotton areas. It is true that in certain areas certain pests give more trouble. For example, the jassid, which as far as our records go, occurs naturally throughout our cotton areas, is a serious pest only under certain conditions and in certain areas. At present, it cannot be said with certainty that any of our major pests occur naturally under any particular conditions as to flora, nature of soil, or climatic factor, although they may fluctuate

* For text of this see page 238.
† See page 242.
‡ Subsequently amended. See page 178.

abundance depending on certain factors as to weather, soil, etc. he only possible exception is the Sudan boll worm, which has not yet een reported from parts of the Cape Province where cotton is grown. wider survey of our cotton areas is necessary before any definite atements can be made.

There is evidence that cultivation, rotations, and size of field as some effect on the occurrence of the major cotton pests; but so any exceptions have arisen, that I have no statement to make until e matter is more thoroughly studied. Experiments along these lines ill be conducted next season."

) Aphides and Jassids.†

The questions raised by the Empire Cotton Growing Corporation ere left in abeyance more or less for the consideration of this ombined session, as far as the matter of formulating replies thereto concerned.

For the information of this meeting I beg to submit the following bservations:—.

1. Mr. Haines (contributed): (a) Natural enemies are umerous in South Africa, as everywhere, on Aphides, and special ention need not be made of them. No study of the natural enemies the jassid has been made. (b) The question of plant selection for sistance will be dealt with by Mr. Parnell, but I might add that long go we noticed that certain cotton plants resisted the jassid, especially ose with hairy leaves and stems. We also noticed that the growing ant was more resistant than the matured plant; and also, that there a definite relationship between jassid attack and rainfall, *i.e.*, olonged periods of wet weather, which seem to hasten jassid attacks. assid occurs, so far as we know, all over the cotton areas, but it has ver given serious trouble in the higher altitudes of these areas, and s only under certain conditions become pestiferous in certain parts our low-veld. (c) Nicotine dust kills the jassid if applied strong ough, but the effect is only transient, as the plants very soon become fested again. Calcium cyanide dust gave very unsatisfactory results. ordeaux mixture, as a dust and a spray, was the only substance that ve results at all lasting, but it is doubtful if it would pay to use it. is certainly not advisable to recommend spraying or dusting as a tisfactory control measure for jassid, as it seems certain that jassid-sistant strains of cotton will be found. (d) We have no direct idence that cultivation makes any difference as to jassid outbreaks cotton, except that well-drained cotton fields seem to delay the tacks somewhat. In general, it seems to hold true that healthy, ll-grown cotton plants withstand jassid attack longer than those ants which are poorly and slowly grown.

2. Mr. Hargreaves stated that in Uganda the *Aphides* was rhaps the most serious pest on Cotton; certainly the accumulated fect appeared to be greater than that of any other insect.

3. Mr. Ritchie suggested that the control of *Aphides* and *ssids* by fungi might be further investigated; a fungus was the most tent controlling factor of *Aphis* in Tanganyika, and he instanced the ccess of a fungus as the controlling factor of West Indian Cane

† See also pages 180 and 181.

hopper *Delphax sacchernora.*

This suggestion was accepted by the Section.

4. Mr. Hardenberg stated that he was experimenting with Nicotine dust and Bordeaux mixture in the control of *Jassids.*

SECTION II.

THE PINK BOLL WORM *(Platyedra Gossypiella).*

A great deal of discussion centres around Pink Boll Worm, particularly as between Entomologists, in whose territories the pest is at yet unknown and those in whose territories it is present. Unfortunately, the discussion was of a limited character, owing to the fact that many territories in which the insect is known or supposed to exist are not represented at this Conference.

(a) *Answers to Questions.*

1. The Entomological Section has been to considerable trouble to formulate, to the best of its ability, replies to the series of questions put forward by the Empire Cotton Growing Corporation, in so far as these questions relate to the Pink Boll Worm.

I am now referring, in particular, to the Agenda, Category VII., item 6. The replies are as follows:

(a) Control by Natural Enemies. There is no effective control by natural enemies. In Egypt one of the parasites present, *Pimpla roborator,* does become common at the end of the season; and it is more than likely that by a thorough knowledge of its bionomics its numbers could be increased early in the year, thus checking the rapid increase in the Boll Worm population. But it can definitely be stated that, without a great deal of research, nothing much can be expected from natural enemies.

(b) and (i) Elimination of Food Plants. While recognising that further work is essential in the determination of native host plants, it can be stated that the value of the elimination of alternative food plants depends on the life-history of the Boll Worm in any given country; this is determined by the climate. In countries with a definite winter, where cotton is a summer crop, the Pink Boll Worm spends the winter as a resting-larva, usually in a " double seed " *i.e.,* two or more half eaten seeds spun together. Under such conditions it is these resting larvae in the numerous old bolls that fall to the ground and escape destruction which carry on the race to the following year, and the elimination of alternative food plants, which probably means nearly or quite all Malvaceous plants, would probably not be economically worth while. But when there is no definite winter, and the Boll Worm breeds continuously throughout the year in a succession of short-cycle generations, the destruction of alternative food plants, in combination with a close season for cotton, is absolutely essential; the moths emerging at the end of the cotton season will then find nowhere to lay their eggs, and as the larvae are unable, on account of the climate, to assume the long-cycle condition, a fair measure of control should be assured by these methods alone.

(c) and (d) Implemental Cultivation and Rotations. While recognising that it might be worth while to experiment, with a view to ascertaining whether sustained submersion by irrigation would be

of value, it can be stated that the only information on implemental cultivation and rotations is applicable only to countries where the Pink Boll Worm undergoes a resting period, and mainly to places where cotton is grown by irrigation. The experiments of Williams and Bishara, in Egypt, conclusively proved that the greater the depth the bolls containing the resting larvae are buried, the fewer survive; the survival at 30 cms. being nil. Secondly, the wetter the land is kept during the winter, the fewer are the survivals next spring; consequently, Bersim (Egyptian Clover), which is frequently irrigated, is a much more suitable crop to follow cotton than the usual alternative in Egypt, namely, wheat, which receives much less water. But where cotton is grown under rainfall conditions and in countries where the resting stage larva of the Pink Boll Worm does not occur, it does not seem likely that rotations would have any effect one way or the other.

(e) Spraying and Dusting. From the nature of the life history of the Pink Boll Worm it cannot be attacked by spraying and dusting. It is just possible that, if the adult moth (as do many other moths) drinks dew, the dew might be poisoned by a calcium arsenate dusting, but it seems unlikely that this would be a practicable means of control.

(f) Trapping Adults. The Pink Boll Worm (in spite of numerous statements to the contrary) is readily attracted to light. Willcocks in Egypt caught 19,000 moths with 18 traps in an acre of cotton in three months, but although the infestation was somewhat less in the trapped plots than in the controlled ones, he did not consider the use of light traps an economical measure. No information is available in regard to trapping by bait.

(g) and (h) Hand-picking or Collecting Larvae in the Field, and Trap-cropping. These methods are considered to be impracticable.

2. With regard to the question raised by the Department of Agriculture, Uganda, concerning the measures adopted for the control of Pink Boll Worm, and the prevention of its spread, it is understood that this enquiry aims at securing from Tanganyika some measure of reassurance, and Mr. Ritchie submits the following remarks:

There are two areas in Tanganyika Territory, near the Uganda border, in which cotton is grown, namely, Bukoba and Mwanza. These areas are not infested with Pink Boll Worm, and there is no connection between them and other areas in Tanganyika Territory in which Pink Boll Worm has been found. In their own interests the Tanganyika Government are making every endeavour to prevent the spread of Pink Boll Worm to the Bukoba and Mwanza areas, and there appears to be every probability that the measures taken to this end will be effective, as there is a buffer zone between the two areas —some 200 miles of barren country clear of cotton.

The reply to the Conference might, therefore, read:—

Tanganyika is endeavouring to prevent the spread of Pink Boll Worm of Cotton from the infested area of the coast and central region to the clean areas of Bukoba and Mwanza, which are adjacent to Uganda.

(b) *Items of Interest.*

1. Distribution.

As regards the distribution of Pink Boll Worm in Africa, the Entomological and Mycological Section found this to be very imperfectly understood, and that it was quite unable to draw up any useful statement.

As regards the presence of the insect in Tanganyika, Mr. Ritchie drew attention to the fact that for many years the Arabs have been growing Peruvian Cotton along the old slave routes, and it is extremely difficult to make them destroy these trees, the cotton from which has been used in the ritual for the dead from time immemorial. These trees are, in some cases, infested with Pink Boll Worm.

There are no records of the insect in Kenya. In that Colony the seed for the Kavirondo area was obtained from Uganda, but that for the cotton grown on the coast was imported from Egypt.

The insect is not yet known in South Africa, nor in the district of Lorenco Marques, although it is present in the northern region of Portuguese East Africa.

The Entomological and Mycological Section has made several recommendations which I have since reduced to the form of resolutions for the consideration of this combined session.

These resolutions are as follows:—*

(1) That steps be taken to secure from each African Territory a report upon the presence or absence of Pink Boll Worm therein, together with a carefully prepared map showing the different cotton growing districts; and, if Pink Boll Worm is present, the areas known to be infested.

(2) That from the information so supplied a map of Africa be prepared for the use of African Entomologists, showing the distribution of cotton cultivation and of Pink Boll Worm.

(3) That the delegation from South Africa, as represented by the Government officials and the officials of the Empire Cotton Growing Corporation, be asked to initiate this project and secure the publication in South Africa of the desired map for distribution.

2. Twin Seeding and Pupation.

From the observations made upon Pink Boll worm in Tanganyika, it would appear that pupation takes place regularly in the soil outside the boll and " twin seeding " is not known to take place. Pupation within the boll is not expected to take place under any climatic conditions, but " twin seeding " should occur whenever there is a definite winter condition, as in South Africa.

3. Alternative Food-Plants of Pink Boll Worm.

After discussing this matter, the Entomological and Mycological Section agreed that the whole question of alternative food-plants is uncertain and open to investigation.

* See also page 181.

In Tanganyika the only known alternative food-plant is the Okra (*Hibiscus esculentus*), whilst in Egypt the ascertained alternative food-plants are *Hibiscus esculentus*, *Hibiscus cannabinus*, and Hollyhocks.

Interesting points in this connection are that, in Tanganyika one of the most important parasites of the Pink Boll worm is only found attacking the larva infesting the Okra, not those infesting Cotton; and, further, that the larva infesting the Okra pupates in the pod and not in the soil. As one delegate suggested, it may be that the form in the Okra is similar to that found infesting *Hibiscus* in Uganda, more especially as in Queensland two distinct Pink Boll worms are also known, one attacking Cotton and one restricted to *Hibiscus*.

4. Pink Boll Worm in Ginneries.

From observations made by Mr. Ritchie, there appears to be a distinct danger of Pink Boll worm being spread from ginneries.

5. Adequacy of Methods of Disinfecting Imported Cotton Seed.*

The general trend of the remarks made in this connection were to the effect that certain methods were adequate, but that certificates to the effect that such methods had been employed were not to be wholly relied upon. In other words, examination and effective treatment at the port of entry was absolutely necessary.

In this connection, it is suggested that each African Territory be asked to furnish a return showing the source of origin, the covering statement and condition of any cotton-seed found to be infested with Pink Boll worm when examined.

SECTION III.

THE SUDAN BOLL WORM† (*Diparopsis castanea*).

(a) Distribution and Status.

The Sudan Boll worm does not appear to have become established or to flourish in Uganda, Tanganyika, and Kenya. It is a serious pest in Nyasaland, Portuguese East Africa, and South Africa: it is known to be present in the Belgian Congo. It is not possible to review its distribution farther afield.

In Nyasaland the insect is widely distributed—the most serious cotton pest and the chief limitation of cotton growing.

In Portuguese East Africa, the Sudan Boll worm occurs wherever cotton is grown. It is a very serious pest—the worst of cotton pests and, in places, is responsible for 80% loss of crops.

In South Africa, it is a very serious pest and, except for parts of the Cape Province, occurs wherever cotton is grown.

(b) History and Habits.

As regards the general history of this insect in places where it is not considered a major pest, it is impossible to furnish the Empire Cotton Growing Corporation with any information.

* See also page 183.
† See also page 182.

(c) Wild Food Plants.

It is recommended that the following conclusion be adopted by the General Conference:—

The study of the wild food-plants of the Sudan Boll worm is a matter of great importance and one that calls for further thorough investigation. In Nyasaland, one record shows it as feeding in *Thespesia;* and in South Africa a record relates to wild cotton. Mr. Hardenberg has suggested that the larvae may feed in the roots of the sweet thorn tree.

(d) Control.

This is dealt with under the following section.

SECTION IV.

CONTROL OF BOLL WORMS OTHER THAN PINK BOLL WORM

The matter of the economic control of other Boll Worms than the Pink Boll Worm, such as the Sudan, the American and Spiny Boll Worms was fully discussed in the light of varied experience, and the following conclusion was arrived at:—

Although a great deal of experimental and investigational work has been done on Sudan, American, and Spiny Boll Worms, this Section is not in a position to make any general recommendation. No economic means of control have yet been devised, but we are of opinion that further investigations are desirable and necessary.

(Sgd.) CLAUDE FULLER,
Chairman, Entomological and Mycological Section.

Nairobi, August 23rd, 1926.

The Cotton, Entomological and Mycological Sections met under the Chairmanship of Mr. Fuller, who read the above report.

COTTON STAINERS.*

Mr. MILLIGAN wished to make it very clear that the injury from stainers was very serious, and that real co-operation with Entomologists was not only desirable but essential. He indicated that those members of the Cotton Section, who had facilities to do so, were willing to help in every way possible, if he could have some general idea of what was required to be done.

A discussion took place on the Chairman's report; and, in connection with cotton stainers, the following conclusion was accepted:—

In view of the immense importance of cotton staining and internal boll-rots to the future development of cotton growing in Africa, this Conference recommends:—

(1) That thorough investigations should be undertaken into the problem, with special reference to the possible rôle played, in transmission, by *Dysdercus* and other suctorial insects.

* See also page 172.

(2) That in some one centre an adequate staff should investigate thoroughly the whole problem in all its aspects; and that the Government of South Africa should be approached, in the first instance, with a view to undertaking this work.

(3) That the programme of work to be adopted should be drafted by the staff of the centre chosen for the major investigation.

(4) That this programme should be circulated to Departments of Agriculture in other cotton growing areas, with a view to complementary work being undertaken by them.

OCCURRENCE OF MAJOR PESTS.

The CHAIRMAN (Mr. Fuller) read Mr. Haines' notes* in regard to the natural occurrence of major pests and their occurrence under conditions of cultivation.

Mr. MILLIGAN said that in the circumstances, he was satisfied with Mr. Haines' somewhat guarded reply.

SENHOR GRILLO made the following statement in regard to the natural occurrence of major pests in relation to climatic factors:

For some years they have been growing cotton in the coastal belt, north of the Zambezi, with unsatisfactory results. Cotton was sown with the first rains, from December to February, and was picked during the cold season—from June to August. The low yields were principally attributed to insect injury, especially bollworms. This experience and also a better understanding of the conditions of soil and climate, induced them to try late planting as against the usual practice elsewhere. During the last four years they have been very successful. The comparative data were as follows:

	Early Planting.	Late Planting.
Rainfall during the season, 45 ins.		20 ins.
Number of days with rain, 55.		35
Temperature declines from 83deg.F. to 60deg.F.		Declines from 75deg.F. to 60deg. F., followed by rise to 82deg.F.
Humidity during picking: 85		65
Predominance of pests: During flowering and boll development: Spiny and American Bollworm: before ripening *Jassid;* later on, *Aphis*.		During young stages of growth *Jassid* and *Aphis*: later on, small attacks of Sudan Bollworm.

Average yield, late sowing, on Lower Zambezi, N.W. during the last four years, 650 lbs. seed cotton per acre. Average yield on Coastal belt, late sowing, during the last two years, Z.H. 248 lbs. seed cotton per acre, but this low yield was due to inexperience on the part of the growers, for averages of from 600 to 800 lbs. and more had been picked on various farms, the maximum obtained in 1924 of cotton

* See page 172.

planted between young coconuts being 1,100 lbs. seed cotton per acre on a plot of 50 acres. In this way they had avoided the boll-worms and other causes which tend to decrease the yield. If irrigation could be applied during the months of August and September when necessary, they felt sure that higher yields could be obtained, and thus cotton growing would be made more profitable.

Mr. KIRBY thought that, in this connection, one point should not be lost sight of and that was the production of early maturing varieties of cotton. Cotton specialists and entomologists might collaborate in an attempt to provide a " pest-avoiding " type.

Mr. DUCKER said that, from his experience, it seemed necessary in Nyasaland to evolve two distinct types to suit the different climatic conditions. Experiments were being made on these lines, and he hoped that more information would be available next year.

Mr. KOCH stated that similar experiments were being carried on in the Union of South Africa.

APHIDES.

The CHAIRMAN (Mr. Fuller) read Mr. Haines' notes*, and said that this question had not been fully discussed by the Entomological Section, as it was suggested that such discussion should be postponed for the Joint Meeting of the Cotton and Entomological Sections.

Taking the question of *Aphis* first, he thought that more work should be done on the natural enemies on a field scale, as dusting and spraying had not proved economical.

Mr. HARDENBERG said that in Portuguese East Africa they did not consider *Aphis* to be a serious pest of cotton; it only damaged the young plants of 6 ins. to 8 ins. high, and when the plants had grown to 18 ins. in height they had outgrown the attack. He considered the damage to be negligible on mature plants.

Mr. MILLIGAN agreed with Mr. Hardenberg's opinion.

Mr. HARGREAVES said that there was a big variation in the incidence of *Aphis* attack correlated with the times of planting. Older plants suffered to some extent. He agreed, however, that the damage was most serious in the case of young plants.

The CHAIRMAN (Mr. Fuller) was of opinion that it depended greatly on the season: he said that you could have an *Aphis* season or not, and that the point was whether any control by planters was feasible or not. No doubt *Aphis* could be controlled, but it seemed to resolve itself into a question of economics.

Mr. RITCHIE stated that in Tanganyika the *Aphis* attack was at its worst from the middle of May to the end of June—just after the heavy rains. The main controlling factor was an indigenous fungus; when this got a hold the field was cleaned up.

The CHAIRMAN (Mr. Fuller) said that there seemed to be no doubt that there were several species of *Aphis* on cotton, and the first essential appeared to be to investigate the various species and the effect on them of climatic conditions.

Mr. MILLIGAN would like to see further experiments done on the lines of Mr. Ritchie's statement.

* See page 173.

The CHAIRMAN (Mr. Fuller) observed that such work must be one by a mycologist.

Mr. MILLIGAN would like to see everything tried which would help in any way to control plant diseases. If they knew that someone was working on these problems they would be more satisfied than they were at present.

JASSIDS.*

Mr. PARNELL made the following statement:—

Jassid is a very important factor in cotton growing in the low veld of the Union of South Africa, and the production of a resistant type is one of the first objects of the Barberton Station.

Cage experiments have proved that the *Jassid (Empoascus Sp.)* directly concerned with the pathological condition under review, and probably entirely responsible without the intervention of any disease organism.

Speaking generally, the intensity of the *Jassid* attack on any one variety depends largely on the health and stage of development of the plant, it being least on a strongly growing immature crop. Various plant-foods appear to affect susceptibility only through their effect on the growing condition of the plant. The susceptibility of different varieties varies enormously, and the results of the last two seasons show that selection for *Jassid*-resistance is a most promising line of work. A decidedly resistant strain, possessing other good qualities, has already been obtained, and will be multiplied, provisionally, on about 200 acres in the coming season.

The nature of the resistance of certain varieties is undoubtedly complicated. Some degree of tolerance exists, also some attribute which discourages the breeding of the pest. In the latter category hairiness, both as regards density and length of hairs, has been shown to be an important factor.

The CHAIRMAN (Mr. Fuller) agreed with the opinion expressed by Mr. Parnell.

PINK BOLL WORM.

The CHAIRMAN (Mr. Fuller) read replies† drafted by the Entomological Section in answer to the questions asked by the Empire Cotton Growing Corporation.

These were accepted, without discussion.

The Chairman reviewed the items of interest in connection with Pink Boll Worm, which had come under discussion by the Entomological Section. A resolution drafted by the Entomological Section in regard to a map of the distribution of the Pink Boll worm in Africa was submitted.‡ It was approved with the suggestion that a note be inserted in the record to the effect that other arrangements should be made for the preparation of a map in the event of the Union Government being unable to undertake it.

* See also page 173.
† See page 174.
‡ See page 176.

SUDAN BOLL WORM *(Diparopsis castanea)*§

The CHAIRMAN (Mr. Fuller) read the following note by Mr. Haines:—

Both sprayings and dustings by lead arsenate, calcium arsenate, Paris green, calcium cyanide, sodium fluosilicate and Bordeaux mixture have been tried very extensively at various times during the past seven years; and all, except Bordeaux mixture, have given negative results. Last season's experiments with calcium arsenate dust gave absolutely negative results; in nearly every instance the controls gave more seed cotton per acre than the treated plots, in applications ranging from one to six. Also the cost of treatment was considerable—in many cases absolutely prohibitive. With Bordeaux mixture, more promising results were obtained but not promising enough to warrant recommendation. Increases in yield, ranging from 30 lbs. to 250 lbs. of seed cotton per acre, were obtained. It is certain that spraying and dusting, as it is done at present, is not a success. At present it appears that our only hope of success lies with Bordeaux mixture, but much more must be learned first about method of application and effect on boll worm and other pests, and on diseases. It is not yet clear exactly what effect Bordeaux mixture has on the boll worms alone. My several years' experience with spraying and dusting for boll worm control has made me very doubtful that it will prove to be an effective remedy. Basing my statement on the data at present available, I can say most emphatically that I am not prepared to recommend this method of control; as a whole, the results obtained have been most discouraging. I might add that our laboratory experiments on the effect of calcium arsenate on the larvae of the Sudan Boll worm seem to indicate that this poison has no effect, in that the larvae reject the poisoned rind of the cotton boll.

Mr. MILLIGAN did not think that it was satisfactory to base results on yields alone in the spraying with Bordeaux mixture: such experiments can only give rough indications. He would like to see the organisation of spraying experiments with Bordeaux mixture carried out on broader lines. He further said that he was strongly of opinion that no stone should be left unturned in an attempt to combat this pest on cotton.

As to spraying and dusting, as methods of control, they did not seem to have any definite figures: spraying would be difficult, especially in South Africa and in places where there is a scarcity of water. Experiments, however ,should be continued, and he was anxious to know whether any results had been obtained by means of trap crops. His Section had had no information on the subject.

Mr. SMEE had conducted one experiment on these lines but had got no results, as he could not get the Sudan Boll worm to feed on any other crop. Cotton as a trap crop had not been tried. Mr. King was working on these lines but his report had not been received.

Mr. HARDENBERG had known of a case in Portuguese East Africa where a planter took the trouble to hand-pick the first infested bolls; and the planter was of the opinion that hand-picking, in that

§ See also page 177.

rticular case, had saved his crop and was, therefore, an economic position.

AMERICAN BOLL WORM.

In reply to Mr. Ritchie, Mr. Parnell stated that he was rather ptical as to the efficacy of maize as a trap crop for the American tton Boll worm.

Mr. RITCHIE stated that, in Tanganyika no *Chloridea* was found cotton bolls after June: there was only one generation on cotton ls in the year. The place of *Chloridea* on maize was taken by a ecies of *Diatraea*.

IMPORTATION OF SEED.*

Mr. MILLIGAN said that the consensus of opinion was that it ust be impressed on all countries how dangerous it was to admit ed on certificate only.

Mr. PARNELL thought that there was no need to import cotton ed in bulk as small quantities, properly disinfected, were sufficient produce, in a few years, the quantity necessary.

Mr. KIRBY intimated that the present best method for nganyika was to import *in bulk* from countries from which there s little risk of the introduction of pests. The Tanganyika importa-ns were entirely from Uganda.

Mr. HARDENBERG agreed with Mr. Kirby that bulk importation seed must be allowed in certain cases in new countries, otherwise rdship might be caused to planters.

Mr. WORTLEY thought that the risk involved in bulk importa-ns was far too great.

CONTROL OF NATIVE COTTON INDUSTRY.

The CHAIRMAN (Mr. Fuller) then read two papers† submitted Mr. Sampson (T.C.(C)Cot.1 and T.C.(C)Cot.2).

Mr. SIMPSON said that in the early days in Uganda seed cotton m Bukoba was allowed to be ginned at an isolated spot near nebbe; also before ginneries were erected in Kenya, Kenya cotton l been ginned in Uganda. Nowadays, no seed cotton was coming only baled cotton from Kenya and the Congo passed through " in nsit " on permit, if properly pressed and baled. He thought that workers could not keep in touch by correspondence, visits should be d to those territories where the desired information could be ained.

Mr. KIRBY supported the idea that it was the duty of officers to ep themselves informed as to what was happening in other places.

CONTROL OF GINNERIES.

The CHAIRMAN (Mr. Fuller) read Mr. Sampson's paper† C.(C)Cot.7) on the control of ginneries, with special reference to e spread of disease.

* See also page 177.

† For text of papers see Appendix.

Mr. SIMPSON explained the construction of the ginneries in Uganda, and the regulations in force there for ginning cotton.

Mr. KIRBY said that the question of ginnery control could be viewed from two different aspects:—

(a) The control of pests.
(b) The mixing of seed.

In regard to the first, adequate legislation was in force in Tanganyika; and in regard to the second, no special measures were necessary at present where only one variety was grown. This latter aspect of the question would arise only where special varieties or qualities of cotton seed are to be distributed.

Mr. KOCH stated that no need for the control of ginneries had yet arisen in the Union, and that it had not received any consideration as the ginnery buildings were, for the most part, of excellent construction and type.

CHAPTER III.

* COFFEE.

(Mr. Trench attended for the discussions on matters connected with coffee.)

BIOLOGICAL CONTROL OF INSECT PESTS, WITH PARTICULAR REFERENCE TO THE CONTROL OF THE COMMON COFFEE MEALY BUG IN KENYA COLONY.

Mr. KIRKPATRICK read the following paper (referred to in the Agenda as T.C.(C)E. & M.2):—

The factors affecting the numerical abundance of insects in nature are as follows:

(a) Climate.
(b) Food Supply.
(c) Parasites.
(d) Predatory Enemies.

In a fairly recent Text Book of Entomology it is stated that these factors are almost wholly beyond man's control, and reliance for the suppression of pests is placed mainly on purely artificial means of destruction or prevention, and agricultural methods such as rotation of crops and other practices of husbandry (7, p. 374)†

With this statement I venture to disagree entirely. While not minimising the value of insecticides and such like means of combating pests, and still less of agricultural methods calculated to modify their activities, it is in the control of climate and food supply, and in the intelligent utilisation of the enemies of destructive insects, that the cheapest, the most efficient, and the most permanent control is to be obtained.

There are doubtless many insect pests which will possibly always be best controlled by purely artificial means, while in probably every instance of an insect suddenly assuming the proportions of a pest, is it necessary to use known and tried methods, such as spraying,

* For other papers on Coffee see Part II., Chapter IV.
† See list of references on page 194.

migation, poisoning, or whatever may happen to be applicable to particular case, to check its rapid spread to a disastrous extent. ten it is possible to effect a temporary check by such methods in a ort space of time, without any very detailed knowledge of the nomics of the insect.

But the practice of Economic Entomology must not rest there. soon as temporary relief has been obtained, if it can be obtained, m old and proved methods of artificial destruction, then is the time tackle the problem seriously, and by detailed research into the sect's bionomics, to discover whether there is not some reasonable pe of utilising one or more of the natural controlling agencies, ich, aided perhaps in some way or other by the hand of man, may ll prove more efficacious in eradicating the pest, than, for instance, e most efficient spray that can be imagined.

Before proceeding to deal with the specific case of aided natural ntrol which is the title of this paper, let us glance again at the four ain causes which in nature keep the numbers of any given species of sect confined, in the main, within reasonable limits.

) Climate.

That rain and drought, heat and cold, humidity and dryness of e atmosphere, have a marked effect on insect life is well known; but actly what these effects are, and precisely what are the optimum imatic conditions for most prolific reproduction, is only imperfectly nown for a very small number of insects. To some it may at first ght appear presumptous to talk of altering climatic conditions to e resulting disadvantage of an insect pest; but though we cannot oduce rain or a drought to order, we can increase or decrease the fects of either on an insect; though we cannot alter the direction of e wind by the fraction of a degree, we can control its force by the ection of wind-breaks; and most important of all, we can control thin comparatively wide limits the conditions of temperature, midity and evaporation actually occurring amongst a growing crop. us in a crop such as coffee, a little extra pruning will cause a freer rculation of air among the leaves, resulting in increased evaporation; mulch on the surface of the soil will decrease the relative humidity, d a cover crop will increase it; shade will raise the mimimum mperature and lower the maximum, at the same time increasing to me extent the relative humidity; and the space between the plants s a very great bearing on the conditions obtaining in the field. But great deal of bio-climatic research is necessary before much dvantage can be reaped from the means which are at our disposal. sects do not live in Stevenson meteorological screens, but in close tact with plants or the soil, consequently ordinary weather records e of little value, and it is absolutely necessary to determine the nditions in the actual places inhabited by the pests under vestigation.

It is hoped that the means will shortly be available to start some o-climatic experiments in a coffee plantation in this neighbourhood.

) Food Supply.

It is just because man plants hundreds of acres of a particular ecies of plant, and eliminates nearly or quite all the indigenous ecies from the area where he is growing that crop, that an insect hich normally has to struggle for existence and is kept down in

numbers by that seldom failing and still more seldom understood process known as the Balance of Nature, is able to assume the proportions of a pest.

It is obvious that no crop can be grown without thus affording an abundant supply of food to any insects which may be able to feed on it; but there are other ways of controlling the food supply of a pest. If the crop is an annual one, it is often possible to enforce a close season, so that for some period of the year the insect is theoretically unable to maintain itself. Again, comparatively few plant-feeding insects are omnivorous or even catholic in their choice of food, while conversely, comparatively few confine themselves rigidly to one species of plant and one only. The majority of insects have a well-founded sense of systematic botany, and feed on all the plants of perhaps one Natural Order, or of one, or it may be two or three genera. The different food plants sometimes affect the life cycle of the insect or its fertility, thus one Egyptian cotton pest *(Oxycarenus hyalinipennis*, Costa) which breeds on all the Malvaceous plants found in Egypt, lays an average of twenty eggs when it feeds on cotton, thirty if it feeds on *Hibiscus esculentus*, and less than ten when its host plant is a species of *Sterculia* (5, p. 101)†

It is thus clear that it may well be an unending task to try to control a pest if it is left unmolested on wild alternative host plants which may be growing in the vicinity of the crop; and that the control of the food supply may often be perfectly practicable, and a necessary adjunct to other methods.

(c) and (d) The Utilisation of Parasitic and Predatory Enemies of Insect Pests.

Under natural conditions, it is very largely the Parasitic and Predatory enemies which almost invariably succeed in keeping the numbers of an insect within reasonable limits. Insects are extremely prolific, there are but few species which lay less than 50 to 100 eggs while with many the number is to be reckoned in thousands. Yet on the average, only two out of each generation survive to reproduce their kind.

But when man has upset the balance that formerly prevailed the story may be a very different one. Food is there in abundance and the insect feeding directly on the plant gets a start over its enemies and increases out of all proportion. It is true that under certain circumstances, even without any assistance from man, these enemies may also increase and in time control the pest. Thus in certain parts of the United States, the Hessian Fly *(Cecidomyia destructor)* is not reckoned to be serious, because as soon as its numbers increase to any extent, its parasites also increase sufficiently to prevent any appreciable damage being done (4, p. 257)† This is not however always the case, and as will be shown shortly, unaided natural control of the Coffee Mealy-bug in this country is almost certainly impossible.

When the balance of nature has been upset by Man, it is therefore necessary for Man to do something artificially to restore that balance.

The larger animals, such as birds, toads, etc., which may be predators on an insect pest, can often be encouraged without much

† See list of references on page 194.

fficulty. As an example of what can be done by legislation to ncrease the numbers of an insectivorous bird, and at the same time s a still better example of what should not be done in the way of discriminate protection, may be cited the case of the Buff-backed gret *(Ardea Ibis)* in Egypt (6)†

This bird was abundant twenty-five years ago, but by 1912, owing o its having been killed off by plume hunters, only two small colonies f a few pairs each remained. A law was then passed for its complete rotection; by 1920 there were at least 100,000 in the country, and y 1924 perhaps nearly a quarter of a million. By this time the bird ad become a serious nuisance in several ways, and doubts were ntertained whether it was really as beneficial as had been stated in estroying the Cotton worm *(Prodenia litura)* and other pests. An nvestigation was therefore undertaken, and the stomachs of numerous irds examined at short intervals over a period of a year. Not one ingle cotton worm was found in any of the stomachs; the only pest f importance on which the bird fed in quantity was the cutworm *Euxoa ypsilon)*, while even the good it thus did was probably endered nugatory by the fact that it also devoured in numbers the ost useful parasite of the cutworm, as well as other beneficial nimals and insects.

The utilisation of the smaller forms of life—insects, protozoa, ungi and bacteria, which may be enemies of an insect pest, naturally resents more difficulties, and cannot be effected simply by the assing of a law. The most obvious method is the introduction of a eneficial organism from a foreign country; and while there have been otable examples of success, as for instance the introduction of the dy-bird *Novius cardinalis* into California to control the Fluted Scale f Citrus *(Icerya purchasi)*, the greater number of attempts turn out o be failures. This may be due to unfavourable climatic conditions i the new country, but perhaps more often the failure is due to some is obvious cause which cannot be ascertained until the experiment as been made. Thus the lady-bird known as the Mealy-bug estroyer *(Cryptolæmus montrouzieri)* has been introduced from ustralia into numerous countries, among which may be mentioned e United States, Egypt, and Kenya. In none of these countries as it been able to maintain itself naturally, though in all three it hrived and bred abundantly in the Laboratory. In America, except a few small areas, the adverse condition appears to be climatic p. 114)†, the winters being too cold for the mealy-bugs to breed, but ot cold enough to force *Cryptolæmus* to hibernate; consequently the dy-bird dies out during the cold weather from scarcity of food. he practice in those parts of America is therefore to breed enormous uantities of this lady-bird artificially, and to liberate them each year, practice which is only economically possible on a very large scale, nd in a country where plenty of skilled labour is obtainable. In this ountry and in Egypt, although the climate is favourable, *Cryptolæmus* ever appeared to survive after liberation for more than a very short eriod. In both cases this was due to their being attacked by ants tending the mealy-bugs; consequently the system of yearly liberation s practised successfully in parts of America, would be useless in ther of these two countries (even were it practicable on the score of xpense and available labour) unless something were also done to ontrol the ants.

† See list of references on page 194.

There remains the utilisation of the indigenous enemies of a pest, which presumably controlled it effectively before the time when, with the growing of a crop on an extensive scale, it had the opportunity to become a pest; and which may well be hoped to control it again, provided that the complicated inter-relations of these beneficial insects with their enemies, and of these latter with their parasites and predators to a third and even fourth degree, can be satisfactorily understood.

The problem of the Common Coffee Mealy-bug in this country affords a good example of what may be possible in this direction.

The Common Coffee Mealy-Bug.

At least five species of true Mealy-bugs of the genus *Pseudococcus* occur on coffee in this Colony. Only one of these, the most abundant and the most dangerous, will be dealt with here.

This is a species which has been identified as *Pseudococcus citri*, Risso, a species which is almost cosmopolitan, and has been recorded from coffee in other countries, but is more usually known as a pest of citrus. In this country not only is it never found on citrus trees, even when these are growing actually among infested coffee, but it is unable to survive when artificially transferred to citrus. It would therefore appear that even if it is anatomically indistinguishable from the true *P. citri*, it is at least a distinct biological species. At first sight this might seem to be a point of scientific interest only, but in reality it is of the utmost practical importance. For instance it is now just as necessary to guard against the introduction into the Colony of the citrus-feeding form of *P. citri*, as if no form of this species were already present. Again it is more than likely—though one cannot be certain on this point—that it would be useless to attempt to introduce any internal parasite of the citrus-feeding form in the hope that it would control the coffee-feeding race. It may be mentioned in this connection that a species of *Pseudococcus* very similar to the coffee-feeding one, has been found in the Ruiru district of Kenya living on a wild shrub; this mealy-bug is very heavily attacked by a parasite which can not be induced to parasitise the coffee mealy-bug.

The Common Coffee Mealy-bug has been known to exist in the Colony since 1909 (1, p. 98)† and is probably indigenous. It breeds on a number of other plants, both cultivated and wild, in addition to coffee; but it is a matter of some difficulty to make a complete list of its host-plants, as not only must microscopical preparations be made of a mealy-bug found living on some other plant, to find out if it is the same systematic species, but it is also necessary to determine by experiments whether or not it is capable of living on coffee, to ascertain whether it is the same biological species.

It is only within the last three years or so that the species has spread to an alarming extent, and it is now to be found widely distributed over the coffee growing area east of Nairobi as far as the Kakusi hills; being most prevalent in the neighbourhoods of Ruiru and Thika. The altitude of infected areas lies as a rule between 5,000 and 5,700 feet; it has however been found on one farm, the altitude of which was as much as 6,500 feet. It appears useless to speculate

† See list of references on page 194.

n the reason for its initial spread a few years ago, but it will be shown resently how, having once escaped even only to a small extent from e controlling agencies which must have held it in subjection so long, s further rapid multiplication was probably inevitable.

The life-history of this mealy-bug, when growing on coffee, may shortly summarised as follows: Generations are continuous roughout the the year: it is almost impossible to estimate accurately e time required for development from egg to adult under natural ld conditions, but in the laboratory this can be accomplished in out 36 days for the female, and 33 for the male. The males mber some 10% of the total, or less; it appears that shade and a gh humidity increase the percentage of males produced, but the gnificance of this is not yet understood. Neither is it yet known to hat extent the male is necessary for the continued reproduction of e species—several generations can certainly be produced partheno-enetically, but experiments which are still in progress seem to be inting to the fact that this method of reproduction cannot go on definitely.

There appear to be two main periods of abundance, each mmencing with or soon after the main flowering periods of the coffee ee, in October and March. The causes influencing these seasons e not yet known with certainty. To some extent the damp but not nduly cold weather at these times of the year is directly favourable the mealy-bug; it also seems probable that the mealy-bug is able breed faster and more prolifically when the buds, flowers, and oung cherries are available as food, then when it has to feed on the ore mature cherries and the leaves. Again the ants attending the aly-bug are more abundant and active during rainy weather, while e rains have an adverse effect on some, at least, of the predatory emies.

No reliable figures have been obtained of the actual number of gs laid by a coffee mealy-bug in this country, but under laboratory ditions in the absence of all enemies, the number of young mealy-gs which survive to about half way through the first instar, averages out 150. Borden (2, p .5)† and other workers give 300—600 as the mber of eggs laid by *P. citri* when feeding on citrus.

For the benefit of those who delight in statistics, it may be stated t at a conservative estimate, at the end of one year, the progeny a single mealy-bug, supposing all to survive, would weigh forty usand million tons.

Fortunately, however, for the coffee planter, some few tons of se mealy-bugs fail to survive; we will therefore now consider the ors which normally destroy the greater proportion of each neration before it reaches maturity, and which, with a little human l, may well destroy all but an infinitesimal part.

Firstly, there are the climatic factors. Little as we know at sent about certain aspects of climate in relation to the Mealy-bug, can be definitely stated that a free circulation of air, resulting in a ered relative humidity, has a controlling effect, and that the worst cks of Mealy-bug are to be found in positions sheltered from the vailing N.E. wind, whether owing to the lie of the land or to the sence of wind-breaks. For this reason, an attack is much less ly to be severe in a young plantation, and when it does occur in a

† See list of references on page 194.

young plantation, it will usually be found that the leeward side of the trees is the worse affected, and those trees which have been so grown that the lower primaries are bunched thickly together and touching the ground.

There are therefore two means at our disposal of helping the climate to control the Mealy-bug; firstly the avoidance of wind-breaks to ensure a free circulation of air through the plantation, and secondly a system of pruning that will avoid numerous primaries touching the ground, thus maintaining a good circulation of air in the tree itself, especially round its base. The rigorous suppression of weeds will also help to keep the relative humidity at a lower figure.

These recommendations are naturally only made from the point of view of controlling the mealy-bug, though they will also assist in the control of several other insect pests of coffee in this country. It is realised that in parts of the country wind-breaks may be essential, although in those districts where mealy-bug attack is most prevalent, they do not appear to be so, at any rate after the coffee has become well established. The suggested elimination of the lowest primaries has however, in the opinion of the Senior Coffee Officer and of the Mycologist, several other advantages, apart from the question of insect pests.

As regards the destruction of alternative food supplies, it is possible that not very much can be accomplished in this direction. Theoretically, a belt at least fifty yards wide should be cleared at the edges of a coffee plantation, and if possible not planted with any crops at all, but at any rate not with a crop that can be a host of mealy-bug or any other coffee pest. This will minimise the risk of infection being carried to the coffee by man or animals; but nothing can eliminate the risk of wind-borne infection; and the principal cause of mealy-bug suddenly appearing in a hitherto uninfected locality is wind—especially "dust-devils" which may pick up leaves and carry them long distances.

Thirdly, the utilisation of indigenous parasites. Only one internal parasite of the common coffee mealy-bug has so far been found in this country, and that appears to be exceedingly rare, so that it has not been possible to obtain enough to breed them. Two mealy-bugs, both of them closely related to that on coffee, have been found on two species of wild plants, and both these mealy-bugs are heavily parasitised by two different species of *Hymenoptera*. Unfortunately, neither of these parasites can be induced to attack the coffee mealy-bug: indeed, were they capable of it, they would probably have done so long ago without any artificial aid.

Practically nothing therefore can be expected from parasites, but in the utilisation of the predatory enemies of the mealy-bug lies the chief hope of combating this pest.

There are already known to exist in this country nearly forty different species of insects which feed on the coffee mealy-bug. Though some of these are scarce and of little practical importance, it will be of interest to give the full list.

Order *Psocoptera*.

About nine species of these small insects are known to prey on the coffee mealy-bug; only one of which, the commonest, has so far been named—*Ectopsocus briggsi*, Mel. This is mainly a dry-weather insect

hich almost disappears during the rains, in the dry seasons however, sometimes multiplies so abundantly as to be able to effect a great mount of good. Three of the other species are at times locally bundant, and two of these appear better able to withstand the wet eather. The remaining ones are all more or less scarce. As a eneral rule the *Psocoptera* perhaps thrive better under shade.

Order *Neuroptera*.

Family *Hemerobiidæ* (Brown Lace-wings).

There are probably four species of this family known to feed on ıe mealy-bug, but none of them is sufficiently common to be of much mportance.

Family *Chrysopidæ* (Green Lace-wings).

Two species are known, one, *Notochrysa antica*, Walk? is scarce, ut the other, *Chrysopa* sp., is at times very abundant. It appears) be most common during dry weather and on plantations which are ot shaded.

Family *Coniopterygidæ*.

One species is known, but it is scarce and of no importance.

Order *Lepidoptera* (Moths).

Eublemma costimacula, Saalm, is a common predator on Green cale *(Lecanium africanum)*, but it is not infrequently found estroying mealy-bug, on which it appears to be increasing in umbers. Its larvæ are very voracious, and should it be able to ·come abundant, this species would account for large quantities of ıealy-bugs. There is one other (unnamed) moth of which the larvæ ıt mealy-bug; it is, however, not common. There are also two other oths the larvæ of which are sometimes found in clusters of mealy-·g, but they appear to be scavengers and not to eat the living bugs.

Order *Coleoptera* (Beetles).

Family *Coccinellidæ* (Lady-birds).

Sixteen species of these most useful insects have been found ·ding on mealy-bug. These are:

Dysis 4-lineata, Sicard. Scarce.
Chilomenes vicina, Muls. Uncommon.
Chilomenes lunata, F.

Alesia aurora, Gerst. (These last two are mainly aphis-feeders, . they readily take to mealy-bug, and, particularly *C. lunata*, are ·reasingly to be found on this pest.)

Alesia posticalis, Frm. Apparently scarce.
Chilocorus discoideus, Crotch. Not common.

Chilocorus angolensis, Crotch. Abundant and universally stributed over the infected areas. Perhaps the most useful of all e lady-birds.

Exochomus nigromaculatus, Goeze. Commonest on Green Scale, ıt also fairly frequent on mealy-bug.

Hyperaspis senegalensis, Muls. Also on Green Scale, but it is ·mmon on mealy-bug provided only that the ant *Pheidole punctulata* absent.

Hyperaspis delicatula, Muls. Abundant and invaluable.
Scymnus guttulatus, Sicard. Nearly as useful as the last species.
Scymnus sp? Also one of the commonest and most important predators.

Platynaspis kollari, Muls. Scarce.
Platynaspis capicola, Crotch. Locally common.
Also two other un-named species, each scarce.

Order *Diptera* (Two-winged Flies).
Family *Syrphidæ*.
Syrphus adligatus, Wied.
Xanthogramma calopus, Lw.
Xanthogramma pfeifferi, Big. These three species are primarily aphis-feeders, but have each on occasions been found devouring mealy-bug. There are probably other species of *Syrphidæ* which may at times feed on mealy-bug.

Family *Agromyzidæ*.

Leucopis sp.? Abundant and invaluable.
As an indication of the relative abundance of some of the commoner of these predators, the following figures show the emergences from some mealy-bug attacked coffee twigs collected in March, 1926, from a plantation which was then, and had been for some time, heavily infected with mealy-bug. The amount of the infected material was such as would go into two boxes each 18 ins. x 11 ins. x 9 ins.

Psocoptera, various species	1831
Chrysopa sp.	3
Eublemma costimacula	9
Chilocorus angolensis	17
Hyperaspis delicatula	232
Scymnus guttulatus	74
Scymnus sp?	282
(Total Lady-birds: 605.)	
Leucopis sp?	283
Total number of Predators ...	2731

It must of course be remembered that as soon as this material was collected, none of these insects were exposed to adverse weather conditions, nor to the depredations of their principal enemy the ant; nothing like the same number would have survived from the same material left to itself in the field.

Why then, with such an abundance of beneficial insects in existence, is the coffee mealy-bug a pest?

Some of these predatory insects have, it is true, their own particular enemies. Thus three of the lady-birds, namely *Chilomenes lunata*, *Hyperaspis senegalensis*, and *Scymnus* sp. are sometimes parasitised by various species of Chalcids. So also are all the four species of Diptera mentioned, and one, at least, of the *Hemerobiids*. But the harm done by these does not amount to much—the two most heavily parasitised, *Hyperaspis* and *Leucopis*, only seem to be attacked to the extent of some 10% at most. There are also several predatory insects which take their toll of the beneficial ones, for instance *Mantids* may catch an occasional lady-bird, and various fossorial wasps sometimes prey on the larvæ of *Chilocorus*. A large

Reduviid bug, *Rhinocoris tibialis*, St., preys on adult *Chilocorus* lady-birds, and may at times work serious havoc among them, while a smaller bug of the same family, *Ploiariodes* sp., appears to specialize on the *Psocids*.

But the real enemy of all, or at any rate of all the commoner predaceous insects, is a small Myrmecine ant, *Pheidole punctulata*, Meyr. This ant attends the coffee mealy-bug for the sake of its sweet secretion. In so doing it in some way favours the growth of the mealy-bug—whether the actual attention of the ants is beneficial, or whether there is merely less mortality among the mealy-bug when the ants are present to act, as they do, as scavengers, is not quite certain. In any case, when kept in the laboratory completely protected from all natural enemies, the mealy-bug multiplies much faster in the presence of this ant.

Again, this ant attacks and destroys most of, and possibly all, the beneficial predatory insects. It is at any rate known to kill the adults of *Chilocorus* and almost certainly their eggs, the adults of both species of *Hyperaspis* and the larvæ of *Scymnus* sp.; the larvæ of *Chrysopa* sp., and the three commoner species of Psocids. It also destroys both adults and larvæ of the imported lady-bird *Crypotolæmus montrouzieri*.

Pheidole punctulata appears to be distributed over the greater part of the area where the common coffee mealy-bug is found, except that it is not yet known to occur west of the Karura river, and in this locality the mealy-bug, though it occurs sporadically, does not appear to assume the proportions of a major pest. It is here attended by a *Camponotine* ant which is presumably not so destructive as *Pheidole* to the predatory insects, and these always seem to be able to deal with an attack of mealy-bug by themselves.

But where *Pheidole* occurs, such unaided natural control is impossible, as the ant breeds faster and increases with the presence of its favourite food, and the mealy-bug increases with the presence of the ant.

It therefore appeared, and was subsequenty abundantly proved by experiments, that if the ants were denied access to an infected coffee tree, the mealy-bug would rapidly be destroyed by its enemies. Actually, under favourable conditions, almost complete eradication of the mealy-bug is affected in about five weeks, though on some plantations, from causes which are at present obscure, a much longer time is taken.

There can however be no doubt but that this procedure of encouraging the already existing enemies of the mealy-bug is the most effective method at present known of combating this pest. The only alternative is spraying, and no spray can be expected to reach quite all the mealy-bugs on a coffee tree; while it will kill many of the predators and drive away the majority of the remainder. In point of fact, there are coffee plantations in this country which were sprayed, and though a temporary benefit was obtained, subsequently became infected worse than before.

The actual method of keeping the ants away from the mealy-bug is a more difficult matter. Poison baits, such as have proved successful against the Argentine Ant (9, p. 12)† and several others have been tried without success, as these ants learn by experience that the bait is poisonous, and once a few workers have been killed, refuse to

† See list of references on page 194.

touch it again. Methods of wholesale destruction, such as the use of Calcium Cyanide, or hot water, would be too costly in cases of serious infestation, as the numbers of individual nests are very large—in places there may be as many as one per square yard. Furthermore it is only after rain when the soil is damp that the queens and the immature stages will be found near the surface; in dry weather the nests may be at a depth of as much as a foot. Consequently the number of days on which such destruction could be effectively practised is limited. However, when a fresh outbreak of mealy-bug in conjunction with *Pheidole* is observed, it would be well worth while to attempt total eradication of the ants while there are still comparatively few nests.

It is consequently necessary, in the majority of cases, to fall back on the use of repellents, and though fair results have been obtained from the use of a high boiling point creosote oil, it is unsatisfactory in many ways, the method of application being slow and somewhat difficult for unskilled labour, while careless use of it may result in damage at any rate to young trees.

We have written to America for a sample of a substance used as a repellent against Gipsy moth caterpillars (3, p. 133), the active principle of which is also tar oil. It is said that this can be applied direct to the bark without injury, and remains efficient with but little attention for two years. Should it prove to be effective against *Pheidole* and reasonably cheap, the mealy-bug problem should be temporarily solved; but a permanent preventative will only be found when and if, by a detailed knowledge of the bionomics of this ant, the means can be found for its complete destruction.

In conclusion, I wish to express my indebtedness to all the scientific officers of the Department of Agriculture for their invaluable help, more especially to Messrs. Anderson, Fox, Trench, and Wilkinson; and to numerous Coffee Planters, particularly to Capt K. E. Dormer, on whose plantation a large number of experiments have been conducted.

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The CHAIRMAN (Mr. Fuller), on behalf of the other delegates n the Section, thanked Mr. Kirkpatrick for, and congratulated him on, is instructive paper. He was impressed by the remarks in regard to ne control of the ant, as in South Africa they were rapidly coming to ne conclusion that the problem of the ant is the one which should be ackled.

In regard to predatory enemies, he was surprised that no mention as made of the *Cetonid*. He had always thought that further nformation in regard to this insect might produce good results. He lso noticed that no mention had been made of Termites in connection ith the destruction of coffee trees, and would be glad to know if such estruction had been observed.

Mr. TRENCH stated that in Kenya, Termites do attack *Grevillea obusta* in dry districts, but he had never seen them attack live coffee lants.

Mr. ANDERSON stated that on coffee plantations, where *Grevillea robusta* and coffee grow together, the *Grevillea* is attacked ut the coffee very rarely.

Mr. KIRKPATRICK, in reply to Mr. Hargreaves, stated that he ad not so far taken any soil samples of the areas infested with Mealy Bug but that he thought that there might be some correlation between oil and the presence of the ant; and he hoped that the Chemist would e able to help in investigating the matter.

Mr. HARDENBERG had recently been looking up records and omparing lists of food plants of various *Coccinellidæ*, and had found nany wrong determinations; and he would ask all Entomologists to ollect data and material in respect of this particular family, in both he adult and immature stages, and to forward these to him. He ad found *Coccinellids* poorly represented in collections, particularly he smaller varieties. In regard to the relation between *Coccinellids* nd *Pheidole* ants, it had been said that the latter prey on the rmer; on the other hand, Mr. Van der Merwe is reported to have und the larvæ of the former living in the nests of the latter. This peared to be strange, as from these conflicting reports they seemed in ne way to prey on one another.

Mr. KIRKPATRICK, in reply to Mr. Hargreaves, stated that he d tried tanglefoot and that it was effective to some extent, as far as e ant was concerned, but that many beneficial ladybirds were pped; also, it rapidly got coated over with dust and thus became eless. In regard to baits, he had tried many but had invariably und that, after a few of the ants had been killed, the remainder were o wary to take the bait.

The CHAIRMAN (Mr. Fuller) agreed with Mr. Kirkpatrick's xperience—that no success had so far attended the attempts to ntrol this ant by baits or traps.

Mr. WILKINSON, in reply to Mr. Fuller, stated that there was o doubt that the spray used in Kenya was very effective against the Iealy Bug, and in cases where the clusters of the Mealy Bug were t thick it undoubtedly killed most of them but it had, at the same me, the effect of killing the predatory insects, and, in the long run, ossibly did more harm than good.

Mr. TRENCH stated that they had found that fields infested with Iealy Bug and cleared up by spraying became worse during the next

season than fields that had not been sprayed. This was due, probably, to the fact that many of the predatory insects had been destroyed.

In reply to Mr. Fuller, he stated that he thought that if they could get rid of the ant they would be able to get rid of the mealy bug also. He asked Mr. Kirkpatrick to explain his remarks in regard to the incidence of mealy bug, as he had stated that it was more prevalent in the lower districts which are more humid, but that it also multiplied in the months of October and March, when the rainy seasons commence.

Mr. KIRKPATRICK thought that the controlling factor at high altitudes was not humidity but cold. There were also other controlling factors. For instance, *Pheidole* breeds faster and is more active during the rainy season, and also the mealy bug breeds more rapidly when feeding on the young leaves and berries than on the old leaves and the mature berries.

Mr. ANDERSON agreed entirely with Mr. Kirkpatrick's opinion in regard to the control of the mealy bug.

It was agreed:—

> That much more work should be done by entomologists in regard to the *Pheidole* ant, and that the question of baits and the destruction of nests is worthy of close investigation. As this ant was of great importance in Kenya, it was recommended that a thorough investigation should be undertaken in Kenya.

A discussion then took place in regard to *Stephanoderes hampei*,* and the possibility of preventing the spread of this pest from Uganda to Kenya; and it was agreed to recommend:—

> That the entomologists in the two territories should meet and discuss the question after visiting the coffee areas to the east and west of Mount Elgon.

LYCIDOCORIS MIMETICUS—A POTENTIAL PEST OF COFFEE

Mr. HARGREAVES read the following paper (referred to in the Agenda as T.C.(C)E. & M.5):—

Although this bug in Uganda has not been responsible for much damage to coffee, it is of considerable importance owing to the serious nature of the damage of which it is capable under favourable conditions.

The insect was first recorded on coffee in Uganda during 1916 and was again noticed on two other estates during 1917. In each instance, judging from the meagre information available, the pest was of minor importance. From 1920 until early 1925 *L. mimeticus* was noticed only on coffee growing in shade so dense that little or no crop could be produced. In 1925, however, an attack on unshaded coffee came to my notice; it occurred on a small portion of an estate which had previously produced very little crop and it seemed that the insect was favoured by some condition of the soil. More recently, small outbreaks have been noticed on unshaded coffee and on trees lightly shaded by Para rubber.

* See also page 64.

Notes on the Life History.

Eggs are laid in the soft green tissues near the tips of stems and branches, usually in the nodes. The average incubation period is eighteen days. The nymphs move actively when disturbed; they are responsible for considerable damage during their five instars which average respectively four, three, four, five, and six days, a total of 22 days. Adults are very active and they quickly take to flight when disturbed; they feed on the same parts as the nymphs and also on somewhat older leaves. The minimum pre-oviposition period was found to be 10 days. Four eggs every day was the usual number laid throughout the egg-laying period, and the maximum number of eggs laid by a female in the laboratory was 454. The maximum longevity of the female was 126 days and that of the male 75 days.

Description of Stages.

The egg is translucent, creamy-white, circular in cross-section, bluntly pointed at both ends, elongated and slightly curved. The length is 1.75 m.m. and the maximum breadth 0.25 m.m. At the outer end are two delicate white filaments, 0.36 m.m. and 0.18 m.m. long, probably for respiratory purposes; around this end of the egg and covering the bases of the filaments is a brownish granular substance secreted by the bug, apparently for protection of the egg. The sole indication of the presence of eggs are the white filaments protruding from the plant tissues; careful examination is necessary to locate the eggs, the filaments being barely visible to the unaided eye.

The nymph is flattened and rather broad in proportion to the length as compared with the adult. There are short hairs on all parts including antennæ, legs and wing-lobes. The general colour dorsally is pale clay-yellow with paired vermillion spots on the abdomen surmounted by tufts of short brown hairs; latero-dorsally between the sixth and seventh abdominal segments is a pair of dark brown spots carrying similar hairs. The legs are creamy white with black spots on the femora and tibiæ but not on the tarsi. The ventral surface is pale yellow. The eyes and first antennal joint are vermillion coloured, the second antennal joint is creamy white with a yellow band near the apex, the third is black, and the fourth reddish-brown. The nymph feeds on the underside of the leaves producing the characteristic spots.

The adult is clothed by short hairs on all parts including the hemelytra. Dorsally the colour is ochrous brown with a median 0.5 m.m. broad, black line on the head and prothorax narrowing on the scutellum and joining the black membraneous part of the hemelytra. Ventrally the body is black with a median pale yellow area extending along the thorax to the fifth abdominal segment. The coxai, femora, and tibiæ are black while the trochanters and first three tarsal joints are pale yellow, the last two being dark brown. The eyes are Indian red. The first three segments of the antennæ are black and the fourth ochrous brown; the lengths of the joints are approximately proportional to the numbers 2—6—4—1. The sexes are slightly different in size, the female being 10 m.m. long and 3 m.m. broad at the base of the hemelytra, while the male is 9 m.m. and 2.5 m.m. excluding the antennæ; the ovipositor is indicated by a ridge in the median line from the seventh abdominal segment to the tip of the abdomen.

Oviposition is effected in the following manner. On the selected site the bug in vertical position with head uppermost grips the surface firmly with all its legs, bending the abdomen almost at right angles to the thorax; the ovipositor is extruded, inserted and gradually pressed up to its base into the stem, the bug swaying slowly from side to side during this act. The egg is then extruded and the ovipositor is first gradually and, owing to the considerable pull necessary, finally removed from the stem with a distinct jerk. The whole operation of oviposition occupies 100 seconds.

Both adults and nymphs feed on young leaves and terminal buds, producing brown patches on the leaves and ultimate death of the leaves and buds. Secondary growth is thus induced and this in turn is attacked in serious infestations, eventually producing dense bushes on which no crop can be borne. So far as is known berries are not attacked.

Factors favouring L. mimeticus.

As indicated earlier in this paper shade and (probably) certain soil conditions favour the presence of the bug. Owing to the fact that the Agricultural Chemist has not yet the facilities necessary for a soil analysis the possible soil factor has not so far been investigated.

Mr. FULLER, in thanking Mr. Hargreaves, asked what the nature of the damage was.

Mr. HARGREAVES: It kills the young shoots and stimulates secondary growth, causing bunching.

The CHAIRMAN (Mr. Fuller): It possibly resembles the effect of "frog-hopper" on the wattle in South Africa. From wattle several species of *Jassids*, also a *Capsid*, have been reported, and trouble occurs more or less regularly, one insect being in the ascendancy at one time and another at another time.

Mr. HARGREAVES, in reply to Mr. Ritchie, stated that the symptoms are similar to the twig infestation of *Colletotrichum*, and that the effect is very similar to that caused by *Antestia*.

Mr. FULLER asked Mr. Hardenberg to explain something of the "witchbroom" formation in wattle.

Mr. HARDENBERG said that he had now more or less come to the conclusion that the insect was not so much to blame. He attributed the damage to the inoculation of a fungus by some insect. The plants were attacked generally at some 6 ft. to 12 ft. above the ground, which is the height at which most of these insects fly. The insects were responsible in some way but he had not really been able to distinguish cause from effect.

The CHAIRMAN (Mr. Fuller) said it would seem that it is simply a disturbance by the insect causing malformation.

Mr. RITCHIE said that a species of *Lycidocoris (L. modestus)* damaging coffee had been reported from the Congo on deeply shaded coffee.

Mr. HARGREAVES stated that the presence of deep shade is the chief factor in the prevalence of *Lycidocoris* in Uganda.

In reply to a question by Mr. Fuller, he said that the bugs suck the juice from the young shoots and leaves, causing spotting; the leaves and terminals eventually die. The damage to the leaves is similar to that caused by *Helopeltis* on tea.

EASURES OTHER THAN HAND-PICKING FOUND PRACTICAL FOR THE CONTROL OF *Antestia* ON COFFEE.

Mr. RITCHIE said that in Tanganyika a poisoned syrup had en used since 1923. This was Zimmermann's formula. Now actically every planter in the Kilimanjaro and Meru areas had used e syrup with satisfactory results. The only damage done had been e to careless application or lack of supervision. Further details re to be found in the Tanganyika Report for 1924-25.

Mr. TRENCH had carried out experiments on spraying, using the llowing mixture:—

¾ oz. Arsenite of Soda.
2 lbs. Jaggery.
4 gallons of water.

This is sprayed over the bush in the form of a mist, and the anters who had used this had had satisfactory results.

Mr. RITCHIE had had no good results with Arsenate of Lead, e Mally formula, but good results with Arsenite of Soda.

The CHAIRMAN (Mr. Fuller) thought that it was possible that e Arsenate of Lead had been precipitated on the leaf and not taken by insects.

Mr. FULLER asked Mr. Trench what effect the spraying had on e finished coffee product; he instanced the case of the Union where e spraying with Arsenate of Lead had affected the flavour acid ntent of the fruit. It took three seasons before the bad effect had rn off. It was also found that by the use of the Mally bait the vour of the fruits of apple, pear and plum were impaired, and it uld be of interest to know whether coffee reacts in the same way.

Mr. HARGREAVES said that experiments in Uganda had shown t by using Mr. Trench's formula the scorching and burning of the age was serious. A method of applying the bait had to be found that the poison did not come into contact with the plant. Strips hessian cloth were soaked in the poison and placed where the cts could get at them, but this method had proved ineffective.

Mr. TRENCH said that as far as he was aware, spraying with enite of Soda had so far had no deleterious effect on the finished fee product.

Mr. RITCHIE, in reply to Mr. Hargreaves, stated that the ying had been effective at 3,000-5,000 feet on Kilamanjaro, and 00-5,000 feet in Arusha. It was apparent that humidity and mperature had to be taken into account.

Mr. FULLER pointed out in this connection that the results med to depend on what Arsenite was used.

Mr. HARGREAVES said that for the earlier experiments the enite was obtained locally; afterwards the Arsenite was made by Government Chemist from white Arsenic and Soda, and still rching resulted.

The CHAIRMAN (Mr. Fuller) stated that experiments were ng conducted in South Africa with the Mally remedy for adult ths, and seemed promising.

Mr. RITCHIE said that in the Kilimanjaro region planters have tried dipping small pieces of Turkey red cloth in a stronger solution of the poison and placing these inside the bush; by this method washing off by rain is obviated. In Tanganyika they were also experimenting with this syrup poison against *Dysdercus*.

The Status of *Gonocephalum simplex*.

Mr. ANDERSON said that *Gonocephalum* did the same damage to coffee trees as cut worms if the trees are stumped back too much or it completely ring barked them. A bait of 60 lbs. of bran mixed with 1 lb. Paris green, spread round each tree, completely destroyed the *Gonocephalum*. 25 lbs. of the mixture, no sweetening agent being necessary, should be used for one acre of coffee. In Kenya this cut worm attacked wheat to a considerable extent, but was not found to a great extent on coffee.

Root Eelworm *(Heterodera radicicola)*.

Mr. RITCHIE said that the eelworm did considerable damage in newly set-out coffee, which had been planted in fields previously planted with general food crops (*i.e.*, land previously infested). He understood that this pest was becoming so serious in the Congo that they were considering the question of budding *Coffea Arabica* on to *Coffea myrthifolia* which was resistant to the pest.

Mr. SMEE stated that Eeelworm was a serious pest on tobacco in Nyasaland. He had no knowledge of it in regard to coffee.

Mr. WILKINSON stated that it occurred in Kenya but had not been found to be a pest.

Mr. HARGREAVES had heard of no report in Uganda that this eelworm was a pest on coffee.

The CHAIRMAN (Mr. Fuller) said that it was a serious pest on fruit trees in the Cape Province. No soil treatment appeared to be of any use; he could only suggest that, in places where it is a pest, a suitable rotation of crops should be tried or that grass should be planted to clear the land first.

Coffee Leaf Disease *(Hemileia vastatrix)*.

Mr. RITCHIE said that Kent's and Jackson's types had been imported into Tanganyika for trial as to their relative resistance to *Hemileia*. In Mysore, where these types were selected, Kent's would appear to have been more resistant to *Hemileia* than local types there, but Jackson's less so. In Tanganyika, Kent's was proving a robust grower, with plenty of leaf, and, while not immune to *Hemileia*, was considerably resistant; their Jackson's was too young to form an opinion, and he had raised this question as he wished to ascertain, from the experience elsewhere, whether the further importation of seed of these types should be recommended.

Mr. McDONALD stated that there were no Kent's or Jackson's in bearing in those parts of Kenya where leaf disease is prevalent. He had been informed that some young trees of these types had been found to be more resistant to leaf disease, but no conclusion was justified from experience in Kenya so far.

Mr. HARGREAVES suggested that humidity was the controlling ctor, but Mr. Ritchie was of the opinion that extremes of any sort, g., over-shading, insufficient shade, excess of humidity, etc., induced e disease.

Mr. WILKINSON, from experience in Kenya and Uganda, ought that temperature was the controlling factor. Trees which d over-cropped were more severely affected but the disease was pable of attacking a healthy tree.

Miss WELSFORD said that there were insufficient trees in nzibar to justify any conclusion. The few trees, that are there, op heavily, although *Hemileia* is present. The trees were not cared r but were fairly well shaded.

ETHODS OF COMBATTING COFFEE LEAF DISEASE *(Hemileia vastatrix)*.

Mr. McDONALD made the following statement:

The methods advocated in Kenya are preventive, not curative. hen the leaf disease fungus has successfully invaded a coffee leaf ere is no method of destroying the parasite without also killing the af.

Chief importance is attached to measures designed to promote e general vigour of the coffee bush and, consequently, its resistance disease. To this end plantations should be kept well cultivated d should not be allowed to become over-run with weeds. Excessive midity must be avoided by attention to ventilation: this includes per pruning and the regulation of shade and wind-breaks to allow e access of air.

Diseased leaves are sources of infection, and must not be allowed remain on the ground; they should either be burned or buried. e latter is the better method as it does not result in loss of valuable mus. Branches which hang down close to the ground should be moved, as they are particularly liable to become infected from ngus spores splashed up from the soil in drops of rain.

Liberal dressings of farmyard manure are valuable in assisting fee bushes to recover from any special strain, such as over-bearing, which they may have been subjected; this assistance helps them resist attack by leaf disease.

Finally, in Kenya the disease may be considerably checked by aying with ½% Bordeaux or Carbide mixture. In most parts of the ntry quicklime, which is necessary for the proper manufacture of former spray, is not available and this fact has led to the adoption Calcium Carbide in place of the lime. The formula for the ½% rbide mixture is as follows:—

2 lbs. Copper Sulphate (Bluestone).
12 ozs. Calcium Carbide.
40 gallons water.

make the spray, the Bluestone is first dissolved in the water in a oden barrel, and the Carbide is then added, a little at a time, out doors.

In districts where leaf disease is prevalent, two sprayings are commended, the first to be completed before the advent of the main iny season, and the second to be carried out as weather conditions rmit, about two months later. The special object of the second

application is to protect the young flush of leaf. In spraying against leaf disease it is essential to wet thoroughly the undersides of the leaves, as it is on that surface that infection takes place. The finest spray nozzle obtainable should be used.

It is not known whether the spraying measures advocated above would be successful in Portuguese East Africa. In Kenya, coffee is grown at altitudes of 4,500 and above.

Mr. RITCHIE from experience with the disease in Tanyanyika, recommended as follows:—

1. The industry should only be attempted in areas where conditions have been observed to be generally suitable for coffee.

2. A robust growing type or types of coffee should be selected suitable to the particular area, a type with strong primary growth and ample leafage. Kent's coffee, so far as Tanganyika trials have gone, is a coffee of this type but other local types (copper tip) appear also to be equally suitable.

3. So far as trials have gone, there is no decided evidence in Tanganyika that spraying with Bordeaux or Carbide mixture exerts any control on *Hemileia*, indeed many planters have given it up. They recognise that the great thing is natural plant vigour and general plantation management to maintain a reserve (*i.e.*, recuperative power) in the plant.

4. There is evidence that coffee left more or less to a free form of growth and not made to conform to a humanly devised pruning system (he referred to vigorous pruning of single stem or low-top coffee), maintains of itself a satisfactorily balanced growth (crop, crop-bearing area, leafage) and is less affected by leaf disease.

Causes of Dieback in Coffee.

Mr. McDONALD read the following statement on the causes of dieback in coffee:—

This short statement deals with coffee dieback as met with in this part of East Africa and is submitted in response to the request of the Government of Nyasaland for information on the subject. Much of what is known of the malady in these parts is due to the work of Dr. Small, lately Mycologist in Uganda, who began investigations on dieback at least as long ago as 1915. Experience has shown, however, that there are few, if any, differences between the problem presented in Uganda and that in Kenya.

The common form of dieback of coffee is characterised by the blackening and drying up of the primary branches from their tips downwards. In bad cases the trouble may even extend to the main stem. As the dessication of the branches proceeds, their leaves and berries are naturally involved and also become brown and dried-up. Eventually such affected branches become reduced, by the shedding of the leaves and berries, to bare brittle sticks. In severe cases, the whole bush may be affected, but the commonest condition is that in which the apical branches and those in the lower half of the bush remain healthy while there is an intermediate zone affected with dieback.

Dieback represents a state of exhaustion and indicates that the affected bush has undergone an excessive strain of some sort. It is never directly due to attack by parasitic agencies, although it may

llow as the aftermath of such attack. Any factor which puts a vere strain on a coffee bush may, therefore, cause dieback of the anches and, in practice, several influences, either single or in mbination, are known to be able to do this. Overbearing, at least Kenya, is the commonest cause of the malady and is the one chiefly sponsible for the condition already mentioned in which there are per and lower regions of healthy branches and an intermediate ssicated zone. The explanation of this appears to be somewhat as llows. The youngest primaries situated near the apex of the bush ve not yet reached the bearing stage, and have, therefore, not been bjected to the strain involved in maturing a crop. Those at the se, although they may be carrying a heavy load of berries, have had ne to produce a system of secondary and tertiary branches to assist the work of providing the food materials necessary to the velopment of the crop. The intermediate branches below the apical ne, while just old enough to come into bearing, have not the dvantage of such secondary and tertiary growth so that, if the crop sufficiently heavy, the strain proves too great and dieback results.

Two parasitic influences which are frequently important as direct causes of dieback are severe attacks of leaf disease *(Hemileia stratrix)* and thrips. These cause extensive defoliation, and unless pecial measures, such as heavy manuring, are taken to assist the covery of the affected bush, dieback invariably follows. In districts here leaf disease is prevalent a bush which is bearing a heavy crop ccumbs much more readily to the disease than one which is not, so at the strain of overbearing is considerably accentuated by attack by e fungus and subsequent dieback is rendered the more certain. sufficient rainfall may in itself be a cause of dieback but it is more ually only a contributory factor, although frequently an important ne. Neglect of proper cultivation has a similar effect by depleting e soil of moisture and also by preventing proper soil aeration. This well seen in the extreme case of a derelict plantation, containing nk growths of weeds; in such places the bushes are invariably badly fected with dieback. Any circumstance which prevents the proper velopment of the root system, such as faulty planting or the esence of hard pan, may also lead to dieback.

It has been stated in the foregoing that dieback is never directly e to parasitic agencies. Many diseases and pests may, of course, use the death of branches which they attack but the effect of such rect parasitism is confined in general to the parts attacked and e phenomena observed belong to a different category from those aracteristic of true dieback. Thrips has been mentioned as a use of severe defoliation leading to dieback; when, however, these ects suck the juices from young branches the parts affected are led as the direct result of such attack and their deaths are not due any way to a general strain thrown on the bush as a whole. rtain fungi, notably *Colletotrichum coffeanum* and a species of *oma*, are almost invariably present on twigs which have succumbed dieback; they become established on such twigs after the event, wever, and are not the original cause of it. These fungi exist quite rulessly and in considerable amount in every coffee plantation, as shown by the fact that one or other may be confidently expected develop on any perfectly healthy coffee twig brought into the boratory and merely kept in a moist chamber for a few days. Only wo cases have been observed in six years in which it seemed at all

probable that *Colletotrichum coffeanum* had become parasitic on coffee branches in this country and in both these cases there were special conditions favouring the fungus. In these instances the attack occurred on isolated twigs and the branches died not from their tips but from the actual point of attack. The name *anthracnose* is better suited to this disease than " dieback," to which actually it bears no relation.

One other malady which may be confused with dieback should also be mentioned. This is known in Kenya as " black tip," and occurs almost exclusively at altitudes above 6,000 feet. It appears to be due in part to the scorching effect of the sun's rays acting through drops of rain or dew and in part to too rapid changes of temperature in the plantation. The operation of these factors causes the deaths of the main growing points of the branches and the consequent stimulation into activity of numerous auxillary buds, so that the production of a bushy growth of secondary shoots behind the tips of the primaries results. The actual killing of the tissues is confined to the ends of the branches, and once the difference is realised there is no difficulty in distinguishing between black tip and dieback proper.

References:

(1) Small, W. Dieback of *Coffea arabica* in Uganda. Circular No. 4, Uganda Department of Agriculture, 1920.

(2) Small, W. The Diseases of *Coffea arabica* in Uganda. Circular No. 9, Uganda Department of Agriculture, 1923.

(3) McDonald, J. Fungoid Diseases of Coffee in Kenya Colony. Bulletin No. 3, Kenya Department of Agriculture, 1925.

Mr. RITCHIE said that in his experience, dieback was less frequent if the long top or multiple stem system was adopted, *i.e.*, when the balance between crop and foliage is more evenly maintained.

Mr. TRENCH observed that dieback was the result of a combination of causes. Pruning on the single stem requires expert knowledge, and dieback may be caused by bad pruning. The multiple stem system does not require so much pruning, and so is probably to be recommended in order to minimize the incidence of dieback.

In reply to Mr. Ritchie, Mr. Trench stated that dieback was not usually serious at the higher altitudes, where growth is sturdy and crops not very heavy.

Methods of Combatting Coffee Stem Borer.

Mr. WILKINSON said that the only stem borer in Kenya was *Apate*—the black borer; this was easily combatted by injecting Carbon bi-sulphide or petrol into the hole in the stem.

Mr. RITCHIE said that in Tanganyika, the white coffee borer *(Anthores leuconotus Pasc.)* is controlled by hand-picking out of the grubs by means of a wire with a hook attached. Where conditions are suitable for coffee, and it is subjected to no set back by over-bearing, leaf disease, etc., borer is easily kept in check. Correct coffee culture to maintain the sap flow and steady growth of the tree is the main essential in borer control. The yellow borer *(Dirphya sp.)* and the *bostrychid* borer *(Apate monacha)* are not of any considerable importance in coffee culture in Tanganyika.

CHAPTER IV.

COCONUTS.

GUMMOSIS IN COCONUTS.

Miss WELSFORD read the following paper:—

During the last ten years an increasing amount of attention has en given to a disease of coconuts which is spoken of as excessive t fall and which is the cause of a diminished crop. It has been tributed to various causes.

The disease was reported from Indo-China in 1920 where it was tributed to lack of nitrogen; in 1921 Gadd recorded it in Ceylon and owed that in that country it was not due to lack of nitrogen but tributed it to a *Phytopthora;* three years later he showed that it as not due to a fungus but was caused by mechanical injury; in 1924 ndararaman in Malabar attributed it to Phytopthora, and in the me year Simmonds in Melanesia found it associated with *otryodiplodia theobromae.* In Kenya, McDonald found it was due insufficient moisture and unfavourable soil conditions. It has also en reported from Tanganyika.

In Zanzibar and Pemba the disease is widespread: not one amba in the Protectorate is known to be entirely free from the sease; it has been very noticeable every year since 1921 when I first me to Zanzibar and has increased during the last two years.

MPTOMS.

The chief symptoms of the disease in Zanzibar are:

1. A great reduction of the crop at all seasons of the year due to
   (a) Abortion of flowers.
   (b) Dropping of developing nuts at all stages.
   (c) Non-development of inflorescences.
2. Associated with this nutfall a deformity of nuts caused by
   (a) Twisted and irregular growth of nuts.
   (b) Formation of lesions in husk.
   (c) The production of drops or masses of hardened gum on the husks.

So far as I know this splitting of husks and gummosis has only n recorded from East Africa. I should like to know if it occurs ewhere. Not only is the disease in Zanzibar serious in that it ormously reduces the crop but also because the nuts which are duced, are to a great extent of very poor quality yielding a small mount of meat and very inferior fibre.

Microscopic Examination of Diseased Nuts.

The lesions which are very conspicuous in the older nuts, can first be detected as faint, pale, waterlogged areas on the green husk and if the nuts are cut open, as faint discolourations scattered in the interior of the husk; they originate internally and are due to the gradual breaking down of the cells, a process which continues till the exterior is reached. The first indication of a lesion is the swelling of the middle layer of the cell wall and the pushing apart of the cells, which have the appearance of being perfectly normal and healthy. A search failed to reveal the presence in or near the lesions of either intracellular or intercellular fungi or bacteria which might, by the secretion of enzymes as with Botrytis, cause a disintegration of the cell wall. No fungi were found in the tissues of the husk near the lesions or in the peduncle. At a later stage the cells of the husk disintegrate and a semi-liquid substance is found in the resulting cavities; when the lesion reaches the surface, one of two things happens, either the liquid does not exude and the exposed fibres dry or the exudation is copious and the liquid dries in the form of hard drops or lumps. There is some evidence that this formation of hard gum is due to a fermentation which occurs in the exuding cell sap in the air owing to the presence of various secondary fungi. A similar formation of gum can be induced artificially if the petiole is cut so as to cause an overflow of sap.

Fungi as Cause of Disease.

As is to be expected the older nuts with dry husks often have a conspicuous growth of fungi, chiefly *Diplodia epicoccus* and a *Glæosporium* but these are not always present on diseased nuts and indeed are more often found on healthy nuts. Suspensions of the spores of the various fungi found were sprayed on the flowers and young nuts of trees bearing healthy inflorescences but in no case was disease induced and no evidence was obtained that they are the cause of the disease.

A study of the peduncle failed to produce any evidence of abnormality in the tissues or any signs of mechanical injury which might check the flow of sap below the inflorescences.

The stems except for past injury due to beetle attack were normal and showed no injury due to fungi. In a few cases on the margin of the cracks in the stem which are due to rapid growth, small colonies of a Sphæronema were found and in two other cases a Thielaviopsis, probably *T. paradoxa*. Microtome sections were made of the surrounding tissue but no marked fungal penetration was found and it was concluded that the fungi were growing on the sap exuded from the cracks in the stem.

Sections of the root failed to show any abnormal condition of the tissues, neither fungi, eelworms nor insect pests have been found.

Non-Fertilisation as cause of the Disease.

Many mature trees produce inflorescences with female flowers which never swell but fall off without developing. When these flowers were examined and compared with the flowers of a healthy inflorescence it was found that the abortion was due to lack of fertilisation; pollination had occured, the pollen had germinated though the tubes were poor but they had not been able to grow down the micropyle as the micropylar canal was closed. In the normal

coconut flower the micropylar passage enlarges about the time of pollination and the cells lining it have a very active appearance with large nuclei; in the flowers of an unhealthy inflorescence the passage remains closed, the epithelial cells are small and shrunken and there is every appearance of lack of moisture, though no evidence of abnormal vascular structure was found.

When the pollen grains from healthy and diseased inflorescences were compared, it was found that a greater proportion of the grains from diseased trees failed to germinate in 20% sugar than was the case with the grains from healthy trees; those that did germinate appeared to be normal. It is thought that failure to obtain fertilisation is due to two things:

1. A lack of the normal amount of the secretion which nourishes the pollen tubes, due to a dryness of the tissues; and

2. The failure of the micropylar canal to enlarge, also due to lack of moisture in the tissues.

In view of the fact that microscopic examination suggests that a lack of sap or a lack of certain substances in the sap is the cause of the unsatisfactory development of the nuts, a study has been begun of the condition of the shambas. The chief points under investigation are (1) the physical condition of the soil, (2) the foods present in the soil, and (3) any condition of mechanical injury which may check the flow of sap to the developing flowers and nuts.

PHYSICAL CONDITION OF THE SOIL.

In Zanzibar and Pemba the coconut is to be found growing under many different conditions but in none of these is it uniformly to be found in a healthy state; here and there all over the islands, scattered amongst the diseased trees, are isolated examples of healthy or apparently healthy trees. A record has been made of the crop from the best part of three shambas in different types of soil and test holes have been made in each case and reported on by the visiting geologist. Each of these shambas had many diseased trees, some of which did not bear any crop; there was no evidence that the soil suffered from drought even during the unusually dry and hot season of 1925 to 1926; there was also no evidence that the soil was at any time water logged. There was, however, one important feature which differed markedly in the three shambas under observation and that was the aeration of the soil. In one shamba where the average crop per tree per annum was 59 nuts, the soil is very sandy and is only sparsely covered with small tufts of grass, so that the soil is well aerated. In the second shamba where the average crop is 39.8 nuts, the soil is slightly heavier and is covered with a thick growth of mixed weeds, which is hoed off three times a year when the ground is roughly broken up and is thus aerated for a short time. In the third shamba the average crop is only 5.3 nuts and here the ground is very closely covered with lalang grass (*Imperator arundinacae*) which is not hoed off, only cut down with the hoe, the ground being never broken up and aerated.

It is suggested that this condition of aeration of the soil is an important factor in the disease; it is obvious from the evidence that it is not the cause of the disease but it may be a contributing cause to the severity of the disease.

A small portion of the shamba with lalang grass has now been cleared of all rhizomes and is kept in a good state of cultivation in order to test the value of soil aeration as a means of checking disease.

Starvation as a Cause of Disease.

Sampson has shown in great detail the importance and role of certain food substances in the life of the coconut, the chief of which are nitrogen, potash, phosphoric acid and lime. The plant obtains these foods from the soil and to a considerable extent from the deeper layers of the soil; part of these food substances are entirely lost to the shamba when the crop is removed but part returns to the soil by the decay of the leaves and other debris. Sampson has shown that a heavy crop uses up a large amount of food and is followed by a period of shortage with a consequent small crop, partly due to the failure of the flowers to set and, partly, to failure to develop properly. These facts regarding the Madras coconut suggest that one of the adverse factors in Zanzibar which causes excessive nut fall may be a lack of the essential food substances, or that these substances though they may be present in sufficient quantity are not in an available form for plant food. In this connection it is noteworthy that it is not uncommon to find unusually good bearers amongst those trees growing in the yards of Arab houses in the town and which probably have access to a rich form of manure from drains and cess pits. However it must not be forgotten that equally good bearers are sometimes to be found in the shambas remote from any known rich food supply and in the midst of barren and diseased trees.

As it is possible that excessive nut fall and the occurence of splits and gummosis may be due or partly due to a shortage of food or of certain food substances, a few preliminary experiments are being carried out to test this assumption.

Owing to the fact that analyses were not available of the coconut soils in 1925 the work has been somewhat handicapped; the only analyses available at that time were those of several clove shambas. In these the clove soils are shown to be lacking in sufficient nitrogen and potash; moreover, it was shown that the soil was acid in reaction.

The coconut is an exhausting crop in as much as a large weight of fruit is removed annually (average at Marhubi in best part of shamba 187lbs. per tree, per annum); the only enrichment which the soil receives is the hoed in grasses, the fallen fruit and other debris, in the case of shambas like Marhubi an infinitesimal amount, as there is little grass and most of the debris is removed for fuel.

I have been able to find a few records of experiments in manuring carried out on coconut estates in different parts of the world and of these the following two reports are of exceptional interest. In the Annual Report from the Experimental agricultural station at Porto Rico for 1915 there is an account of manuring experiments which have been in progress since 1912. It was found that in the first two years the manure had little effect on the yield of nuts but after that there was a marked increase in the crop. Trees which had received a manure containing 6% nitrogen, 8% phosphoric acid, and 12% potash in the proportion of 10 lbs. per tree per annum gave a gain of 30 nuts per annum per tree above the control, whilst those receiving 20 lbs. of the same manure gave an increase of 60 nuts per annum

er tree above the control. Moreover it was found that the complete anure was essential; if the ntirogen or potash was omitted there was nly a very slight gain in the crop.

In the Annual Report of the Director of Agriculture for Ceylon r 1915 there is an account of some experiments in manuring coconuts. n Ceylon the soil is deficient in phosphoric acid, also the ratio of hosphoric acid to nitrogen is low.

It was found that complete manure raised the yield of nuts from 9 to 57 per tree per annum (96%) and a complete soluble manure very six months raised the yield from 23.4 to 54 per tree per annum 131%). A leguminous mulch with basic slag and kainet in equal arts, 400 lbs. per acre raised the nuts from 30.7 to 56 per tree per nnum. It was also found that manure increases the power of the ree to retain its nuts.

Working from the results obtained in Ceylon and Porto Rico a mall series of experiments was begun a year ago to test the effect of ertain manures on excessive nut fall and gummosis.

Expt. 1. Effect of a complete manure consisting of:
$1\frac{1}{2}$ lbs. muriate of potash;
5 lbs. basic slag;
$3\frac{1}{2}$ lbs. nitrate of lime per tree per annum.

Expt. 2. Effect of above with the nitrate of lime omitted.

Expt. 3. Effect of 10 lbs. of poonac per tree per annum. This is a composite but not complete manure which is available at a low price in Zanzibar, whether it is cheap as a manure remains to be tested.

Expt. 4. Effect of 40 lbs. of lime per tree every three years.

Expt. 5. Effect of 3 lbs. of coconut husk ash per tree per annum.

Expt. 6. Effect of 6 lbs. of coconut husk ash per tree per annum.

In accordance with the results obtained in other countries and eady described, no increase has been found in the crop during the rst year.

In June, 1925, the D. of A. with another purpose in view manured ree plots respectively with muriate of potash, sulphate of potash and uperphosphate; these plots are also under observation to see what ffect if any, these single manures have on excessive nut fall and mmosis.

It will be another two years at least before the experiments yield nclusive evidence that starvation is, or is not, the chief cause of xcessive bud fall. The balance of the evidence from this and other ountries is that there is at least some connection between them.

Mechanical Injury as Cause of Disease.

Mechanical injury may check the flow of sap and so cause the tarvation of certain buds and inflorescences. In Ceylon, Gadd onsiders that mechanical injury such as the fracture of the peduncle the cause of excessive bud fall. An examination of a large number inflorescences bearing aborted flowers or diseased nuts, did not eveal the presence of any such injuries; similarly the examination a number of unopened spathes did not result in the finding of aterpillars or other insects damaging the stalks or flowers. In Malay oth *Batrachedra arenosella* and *Tirathaba* damage many of the male flowers within the spathe.

At last it was noticed that in a few trees the inflorescences on one side always aborted whilst those on the other side of the tree produced good nuts; on examination it was found that the stem and many of the petioles had been damaged by rhinoceros bettle on the side of the bad nuts. After this a close search was made of a number of trees bearing diseased nuts or abortive inflorescences and it was found in nearly all cases that petioles had been nibbled and holes eaten in the trunk. Recently a tree which had borne an excellent record for both nuts and inflorescences for the last 13 months was noticed to be deteriorating, some of the young nuts were developing lesions, and a young inflorescence dropped all its female flowers. When examined petioles were found to have been eaten and there was much frass; though the actual beetle was not found there was abundant evidence that the tree had been damaged by rhinoceros beetle.

Conclusion.

It is suggested, that the evidence regarding nut fall and gummosis in Zanzibar, though at present very incomplete, points to the lack of nutrition as being the cause of the disease. This mal-nutrition may be general, due to lack of food or water in the soil or to inactive roots, the result of poor aeration of the soil. Or, it may be local and be due to the cutting off of the food supply from the inflorescences, the result of mechanical injury caused by the rhinoceros beetle.

There is evidence that our Zanzibar coconuts are living near the line of starvation and that any aggravation of the adverse conditions tends to increase the symptoms of nut fall.

In Zanzibar there is no attempt to manure the trees and very little cultivation is done; moreover the rhinoceros beetle has increased in recent years.

I shall be very grateful for any information which you can give me as to the occurrence of excessive nutfall and gummosis in other countries and its treatment.

Mr. BAILEY said that this disease was very prevalent in the coastal area of Kenya, and especially to the south of Mombasa where it caused very considerable loss. The soil was very shallow and poor in this district, with the exception of the river flats; and whereas the disease was prevalent on the shallow soils he had not observed it on the richer lands bordering the rivers where subsoil moisture was available.

THE CULTURE OF COCONUTS IN THE SEYCHELLES.

Mr. Fuller read a paper* submitted by the Director of Agriculture, Seychelles (referred to in Agenda as T.C.(C)Ag.17).

THE CONTROL OF THE RHINOCEROS BEETLE.

Mr. ANDERSON said that traps had been successful in Kenya, and he would submit details to Miss Welsford.

Mr. RITCHIE stated that *Oryctes monoceros* also breeds extensively in the wild palms *Borassus*, *Phœnix*, and *Hyphæne*, and in decaying sisal bases.

* For text of this paper see Appendix.

Mr. HARDENBERG said that, usually, the coconut plantations pt a number of boys to collect the rhinoceros beetle and *yncophorus;* the number of beetles which each boy had to collect ried according to the severity of the infestations. This procedure as especially followed in the new plantations.

In February, 1923, a cyclone uprooted some 50,000 trees in the strict of Euclimane. Naturally, it was not possible to destroy all ese stems in a short time, and as a result the number of beetles creased considerably, and the planters were forced to employ a eater number of boys to deal with the situation. Three inspectors olice) were commissioned to visit the properties and compel the oprietors to cut down and burn the dead trunks. After one year of stained effort, the coconut plantations reverted to the original mber of collectors as before the disaster, requiring the same number beetles to be brought in. This method of collecting by boys had oved fairly successful.

The use of traps, by leaving the dead trunks lying for two or ree months, could be recommended, with the two following ecautions:—

(1) The planter must not forget these trunks.

(2) For these traps no trunks must be employed which have died of "bud rot."

(The following discussion took place at a joint meeting of the gricultural, Entomological and Mycological Sections.)

The CHAIRMAN (Mr. Fuller) referred to the paper contributed the Director of Agriculture, Seychelles, which had been read in e Entomological Section.

It was agreed that a letter should be addressed to the Seychelles, anking the Director of Agriculture for his paper.

Mr. HOLM asked for information from neighbouring territories to:—

(1) Whether it was practicable or advisable to prohibit the tapping of coconuts.

(2) What steps were possible to prevent the thieving of nuts.

Mr. KIRKHAM stated that in Zanzibar, tapping was strictly ohibited. In regard to thefts, no one was allowed to be in possession more than ten nuts without a permit, which was issued only to ntation owners or to licenced dealers. This regulation could not said to prevent thefts, but it certainly had some measure of success.

Mr. KIRBY said that in Tanganyika, Government had the power prevent tapping in prescribed areas, as required. In regard to ts, the Department of Agriculture had suggested legislation on the s of the Zanzibar regulations, but such legislation had not so far n approved.

Mr. HOLM was very interested to hear that Zanzibar had found it was practicable to prohibit the tapping of coconut palms, and t Tanganyika possessed the power to do so. This information was eresting, in as much as the populations of the Kenya coastal area l of Zanzibar were very similar. Opinions had been expressed in nya that it would be unreasonable to enforce such rules, as the

populations were dependent to a certain extent on Tembo Tamu for food purposes. In view of the experience in Zanzibar, the question might now be re-opened in Kenya.

CHAPTER V.

MYCOLOGICAL QUESTIONS.

CONTROL OF STREAK DISEASE ON MAIZE AND SUGAR CANE.

The CHAIRMAN (Mr. Fuller) read the following note contributed by Mr. H. Storey, Mycologist, Union of South Africa:—

MAIZE.

(1) We find this disease to be naturally controlled climatically, its occurrence being rare above 4,000 feet. Generally the incidence of infection is greater the lower the altitude.

(2) In the coastal region (and, to a variable extent, inland) the incidence of infection increases as the season advances.

(3) Where a succession of maize crops is planted at intervals in an area, streak is generally more prevalent than where the whole crop is planted at one time.

(4) We have been able to prove that the insect-vector (*Balclutha mbila* Naude) may survive in an infective condition through the winter from one season's maize crop to the next. We believe that this is the important manner of over-wintering of the disease virus, and that secondary host-plants play an unimportant part.

(5) Our recommendations for streak control aim at curtailing the over-wintering and preventing the building up of infection before the main crop is planted by:—

(a) Destroying all over-wintering volunteer maize plants.
(b) Avoiding any early spring planting before the main crop.

(6) Our trials have failed to show any marked resistance in standard varieties, and only slight indications of individual resistance within varieties.

SUGAR CANE.

(1) The deleterious effect of this disease is now generally admitted by cane planters. Even where secondary infection takes place rapidly the advantages of planting healthy seed is shown in tonnage return.

(2) This disease is firmly established in South Africa, probably 30% of the Uba cane now growing being diseased. There is great regional variation in the incidence of secondary infection, which we have been unable to correlate with any known factor.

(3) Control by selection and roguing has been successful in regions not subject to severe secondary infection, but has generally failed elsewhere. It is as yet uncertain whether the transport of planting material from the favoured areas will be generally adopted as a means of reducing losses from streak disease.

(4) It is clear that many varieties of sugar cane are at present immune or highly resistant to streak disease. In particular, the P.O.J. Chunnee-Cheribon crosses and D.1135 have proved immune under local conditions.

Mr. RITCHIE said that at Morogoro, on the experimental plot, here was 100% infection of streak disease on maize. The insects resent were *Aphis maidis* and *Peregrinus maidis*. The possibility of nsect vectors other than that found in South Africa must be onsidered.

Mr. KIRKPATRICK had found only one insect on streak that as likely to be a vector; this was an undetermined *Jassid*.

Mr. RITCHIE considered that soil and weather conditions were he chief factors which predispose plants to this disease.

Mr. ANDERSON, in reply to Mr. Ritchie, stated that there was o record of *Peregrinus* on maize in Kenya.

Mr. McDONALD said that streak had never been reported on ugar cane in Kenya, and it had not been possible, in Kenya, to ransmit streak disease experimentally by insects. (NOTE: Since this tatement was made streak disease has been found on sugar cane in Kenya.)

SUGAR MOSAIC DISEASE.

Mr. FULLER read the following note contributed by Mr. Storey, Mycologist, Union of South Africa:—

(1) The situation in South Africa is unusual, since 99.8% of the ane area is planted to the variety Uba, believed to be truly immune o mosaic. Among the balance the spread of mosaic has been rapid, ince the distribution ten years ago of diseased stocks of the tolerant .O.J. seedling varieties.

(2) The proposal to eradicate the small quantity of susceptible ne has not yet been adopted owing to difficulties over compensation.

(3) A local eradication campaign conducted by one concern ntrolling 20,000 acres has given very promising results.

(4) This campaign has shown the great difficulty in completely stroying the roots of cane, even where ploughing out is followed by llow and planting with such a rank grower as Uba. We consider casional row-by-row inspections to be necessary periodically for two ars after the ploughing out.

(5) We are importing (under strict quarantine) immune varieties m different countries, and in future years will be in a position to pply cuttings to other African territories.

ROSETTE DISEASE OF GROUND NUTS.

Mr. FULLER read the following note contributed by Mr. Storey, Mycologist, Union of South Africa:—

(1) We have fully established the relation of *Aphis leguminosæ* heo to the transmission of this disease.

(2) We are endeavouring to find the manner of over-wintering f the virus, as offering the greatest prospect of devising control easures.

(3) In the normal season effective control of losses is obtained planting at as early a date as will allow of good growth of the plant November in N. Transvaal).

(4) There is some evidence to show that roguing out of the early diseased plants (which occur in well-marked patches) checks the later spread.

(5) In trials we have found no variety showing markedly greater resistance than the Virginia Bunch variety. Attempts to select resistant lines within standard varieties are in progress.

Mr. RITCHIE said that this disease had been in Tanganyika for a very long time indeed. Under unfavourable weather conditions and when ground nuts are planted on exhausted soils a higher infection is noticed. In cases where there was a high incidence, it could not apparently be always correlated with suctorial insects.

Mr. FULLER observed that entomologists have still a lot to find out about the relation between insects and Rosette.

SOME FACTORS INFLUENCING THE OCCURRENCE AND DISTRIBUTION OF PLANT DISEASES IN KENYA.

Mr. McDONALD read the following paper (referred to in Agenda as T.C.(C) E.& M.3):

From the point of view of the investigation of biological problems connected with agriculture, Kenya presents a most interesting and varied field. This is particularly the case in the study of the causes which determine the occurrence and distribution of plant diseases.

Every factor of importance bearing on this subject may be placed in one or other of the following three groups:

1. Climatic.
2. Economic.
3. Cultural.

Of these groups the first exerts the profoundest influence in Kenya. The general climate of a country is due primarily of course to its particular position on the earth's surface, but local geographical features may modify the climate of different districts. In Kenya these secondary features are so pronounced and varied that they produce a really remarkable diversity of climatic conditions within the borders of the colony.

To appreciate this it is necessary to know something about the geography of the country for which purpose the line of the railway from Mombasa on the Coast to Kisumu on Lake Victoria will serve as a convenient basis. Beginning at Mombasa, which is practically at sea level, the altitude increases fairly steadily till it reaches 5,500 feet at Nairobi, 300 miles inland. The next 30 miles are much steeper as far as Uplands, at the top of the Kikuyu Escarpment, where the altitude is over 8,000 feet. After Uplands there is a sudden fall of about 2,000 feet to the floor of the Rift Valley which runs north and south across the whole country. On the other side of the valley there is another steep ascent to over 8,000 feet at Mau Summit and thereafter the country falls away, steeply at first and then more gradually till the Lake is reached at Kisumu at about 3,700 feet. The main mass of the highland country lies chiefly to the north of the railway between Nairobi and Kisumu, the highest point at which farming is carried on being in the neighbourhood of 10,000 feet.

The seasonal and geographical distribution of the rainfall has a siderable bearing on the subject of this paper. Kenya straddles equator and is well within the limits of the two tropics. Hence it uld comply with the general rule that in the tropics rainy seasons ow a month or two after the sun's passage overhead in its northerly l southerly movements. Thus in Kenya we should have two well-rked and well separated rainy seasons and this actually is the case r a great part of the country. In the western districts, however, ween the Rift Valley and Mount Elgon in particular, the two seasons more or less merged and the rains are fairly evenly distributed over months from March to October, with no well-marked dry weather iod except perhaps in December and January.

The rainfall of Kenya varies in different parts from under 10 to rly 100 inches per annum and, as would be expected, the highest as are in general the wettest. There are, however, two notable eptions to the rule, one of which, the Coast belt, forms the northern remity of a long strip of coast land, stretching for many hundreds niles along the East African Coast and having a comparatively high ıfall. The other exception consists of a number of small districts altitudes of between four and five thousand feet, which, owing to ir position at the bases of lofty escarpments, enjoy a high rainfall to the cooling of the moisture-laden winds which strike the untains. The average annual rainfall of 83 inches at a station in of these districts is actually the highest recorded in the colony.

The temperature varies fairly consistently with the altitude oughout the country from the tropical heat near the coast to the tic cold on the summit of Mount Kenya. The temperature of coast itself is tempered by its proximity to the ocean. Some of higher farming districts are subject to occasional frosts; in fact, year within 25 miles of Nairobi, many acres of native crops were ed by frost. Thick Scotch mists are also frequent at certain ons at such altitudes.

It will be readily appreciated that combinations of the different ees of rainfall, altitude and temperature which have been ribed, complicated as they are by the existence of distinct one and seasonal rainfall areas, present possibilities of very varied climatic litions in Kenya. It is not proposed to enumerate all these, but ay be of interest to indicate the chief types to be found in the cipal farming areas which are situated at the higher elevations. ie term " uplands " is used to denote land within the altitudinal e of 4,000 to 6,000 feet and the term " highlands " as meaning hing above 6,000 feet then there are,

East of the Rift Valley, fairly cool uplands with moderate rainfall 40 inches), cool to cold highlands with mist and frost at times and ntiful rainfall, both these types being combined with two-seasonal ıfall.

West of the Rift Valley, combined with one-seasonal rainfall, re are warm uplands with good rainfall, warm uplands with high ıfall, cool highlands with good rainfall, cool to cold highlands with t and frost at times and high rainfall.

It has been pointed out in the foregoing that the general climate continent may be modified by local geographical features within untry. This may be carried a step further. The conditions

prevailing in different parts of the same farm, indeed even in small groups of plants or, ultimately, in the immediate vicinity of single plants of field or plantation crops are susceptible of considerable modification in certain directions. Thus rank growths of weeds may assist in maintaining a higher degree of humidity in the atmosphere surrounding the crop plants and, if allowed to persist into the dry season, produce, by depleting the soil moisture, soil conditions characteristic in certain respects of a district of less rainfall. In plantation crops the presence or absence of wind-breaks or shade trees and the amount of pruning carried out may alter considerably the humidity and the daily range of temperature which the trees experience.

A few instances from actual experience will help to illustrate some of the points it is desired to make. Coffee, which is one of the chief crops of the country, is particularly useful for the purpose. It is grown in Kenya at altitudes of 4,500 feet to 7,000 feet and is subject to several diseases, some of which are very considerably limited in severity and distribution by climatic factors.

Leaf disease, or rust, of coffee requires warmth and moisture to enable it to do serious damage. Temperature, however, is much the more important factor and, although the disease becomes very destructive in a warm district with heavy rainfall, actual rain is not an essential. Heavy dews are sufficient to enable the leaf disease fungus to attack its host. Thus in Kenya, while the worst cases of leaf disease occur in the lower coffee districts with high rainfall, scarcely less important outbreaks frequently occur in other districts of similar altitude where the rainfall is often so deficient as to cause anxiety to the farmer. On the other hand the disease is rarely common above 6,000 feet except where climatic conditions have been modified in favour of the fungus by the provision of excessive windbreaks, or by allowing the plantation to become neglected. It has been stated that there is evidence in India and also in Kenya that the virulence of the attack of leaf disease lessens after the first onset (1) (2).* Experience of recent years does not appear to support this view as far as this country is concerned. Quite mature plantations continue to suffer extensive defoliation whenever climatic conditions are favourable to the fungus.

Coffee berry disease which attacks green coffee berries is apparently peculiar to Kenya and is a malady which is favoured by very different conditions from those which encourage leaf disease. The former requires almost constantly wet conditions but can tolerate comparatively low temperatures. Thus it is only serious at certain high altitudes with good rainfall distributed evenly over the year and it is not anticipated that it will ever become established to the east of the Rift Valley, at any rate at the lower altitudes. This berry disease does not occur everywhere climatic conditions are favourable and it seems therefore that other factors are involved amongst which nutrition is probably important.

Pink disease, which kills the branches and main stems of coffee bushes, affords a good illustration of the effects of very local influences on general climatic factors. The disease in Kenya is confined to districts with high rainfall—50 inches or more—but altitude appears to make little difference. Given sufficient rainfall, however, pink disease does not necessarily follow. Local conditions causing deficient

* See list of references, page 220.

tilation and high humidity in the plantations are essential, and se follow on the provision of excess shade and the presence of such lacles to the passage of air as dense forest immediately adjoining coffee. The worst case of pink disease seen in Kenya occurred on ee where shade, provided chiefly as protection against hail, had n so overdone as to produce conditions of semi-darkness in the ntation. When the shade was reduced to about a quarter, pink ase was diminished to negligible proportions. That low humidity a controlling factor for pink disease is shown by the fact that on er plantations it occurs only on the few rows of coffee immediately acent to thick forest. Further out, where the air is able to circulate re freely, the bushes are often quite free from the disease.

The influence of climate on Kenya coffee is strikingly seen in yet ther direction. On many plantations at altitudes of 6,000 feet and wards the malady known locally as " black tip " may frequently observed over large acreages. Black tip is a purely physiological enomenon and is characterised by the deaths of the growing points the young shoots. Too sudden change of temperature from that the day to that of the night is undoubtedly one of the principal tors involved but the effect of the sun's rays on the tender tissues the growing points, acting through drops of rain and dew in the ly morning or after showers, also has a considerable influence in ducing the effects observed. Resulting from the deaths of the minal growing points, numerous buds near the branch tips are mulated into growth. These make progress for a short time only be affected in turn by the same unfavourable influences. The killed s of the branches turn black and the leaves in the vicinity are ially dwarfed and crinkled and of an unhealthy yellowish pearance while the bushes as a whole assume a typical conical ape. The introduction of quite a light shade has a marked beneficial ect both by affording protection from the sun and by reducing the of change of temperature in the plantation. Incidentally it is noticeable that the shoots produced in the interior of the bushes unaffected by the malady.

One notable example of the effect of climate on the distribution disease is supplied in the case of wheat which is grown in Kenya at itudes from 4,500 to 10,000 feet. This crop is subject to attack by e rusts, namely black rust *(Puccinia graminis)*, orange rust *(P. cina)*, and yellow rust *(P. glumarum)*. The first two occur erever wheat is grown, but the last appears to be sharply limited hose districts which are situated above the 7,000 feet contour.

It has been stated (2)* that certain early maturing wheats which susceptible to black stem rust may be grown successfully in Kenya own early enough to allow of their nearing the ripening stage before onset of rust attack. This is correct in theory and, in fact, was cessfully put into practice by a few farmers for a number of years. earlier attack of rust in 1922, however, caused considerable damage such susceptible wheats and their use has now been discontinued actically entirely in favour of resistant varieties.

Sufficient has been said to emphasise the importance of climatic tors on the prevalence or otherwise of fungous diseases in the crops the country. Other influences, however, have also to be considered. nature there is a constant war between host plants and their rasites but amongst wild plants a fairly even balance has been

* See list of references on page 220.

struck during the course of ages. Sometimes some local condition may favour temporarily one side or the other, but soon again the normal is restored. In the case of cultivated crops, however, the conditions of nature have been rudely disturbed especially by the crowding together of large numbers of plants of the same species or variety. In the wild state such plants were probably separated from one another by a considerable number of others of a variety of kinds so that parasites feeding on particular species had to traverse appreciable, and in some cases considerable, distances before encountering another suitable host. In cultivated crops the proximity of plants of the same kind facilitates greatly the spread of disease. On the other hand, however, a compensating gain is derived by cultivated crops from the fact that they are grown under much less competitive conditions, so that their general vigour and consequent resistance to diseases tend to be increased.

In a new country like Kenya, situated at great distance from its principal markets, the number of crops which can be grown profitably is considerably limited and this has led to the growing of many successive crops of the same kind on the same land. One farmer is known to have grown last year, his eleventh successive maize crop on the same field and this is by no means a record for Kenya. Considering that in spite of lack of manuring, a crop of 10 bags to the acre was still obtainable from the land, it will readily be appreciated that the temptation to continue the system is a strong one. Nevertheless such methods of farming add greatly to the difficulties of disease control and operate adversely in two ways. In the first place they tend to increase the range of distribution of diseases. Most fungi have little difficulty in tiding over the period from one season to the next so that when such parasites are provided year after year with just the food they require, there is every opportunity and encouragement for their spread to previously uninfected places in the vicinity. An excellent example of this was seen in this country some years ago in the case of flax. In many places this crop became infected with the wilt fungus which started in small patches in the fields. When crop after crop of flax was grown on such infected land, the patches of disease grew larger each year until many acres became so heavily infected that flax could not be grown on them. The same disease exists in Ireland, but it is not a great source of trouble there because in that country the crop is only grown once in a seven years rotation. Head smut of maize which exists in certain parts of Kenya, is another disease which is likely to give considerable trouble in future if no crop rotation is practised. Experience in this and other countries suggests that quite a short rotation (probably of three years) would be sufficient to keep head smut in check.

The second evil effect of lack of rotation is the tendency towards the weakening of the resistance of the crop to diseases through the depletion of essential food materials in the soil. So many other factors help to obscure the effect of this that it is difficult to give instances to illustrate it. In maize, however, the amount of disease in Kenya has been steadily on the increase of recent years (although the loss due to this cause is still not very great) and I am confident that continuous drain on soil nutriments has played a considerable part in bringing about this increase. The Helminthosporium leaf blight of maize comes to mind as an instance of disease which is probably specially favoured by the reduced resistance of the plant

der continuous cropping. It is difficult, nevertheless, to distinguish ween the evil effects due to this cause and those due to the umulation of infective material in the soil in the debris from vious crops. In either case lack of rotation is the important factor d there seems to be no reason why losses due to maize diseases uld not continue to increase while present methods persist.

The influence of cultural factors has not been dealt with separately ause, except in so far as they have a modifying influence on local matic conditions, they present few points which are not common most countries. One instance, however, may be of interest, mely, that of overbearing in coffee. This factor causes more loss an is generally realised and plays an important part in the case of o diseases. Bearing a heavy crop is a great strain on a coffee bush d one which is accentuated by deficient rainfall. The strain is rticularly felt by young coffee bearing a heavy maiden crop before has time to establish a system of secondary branches to assist in the rk of food manufacture. It is very noticeable, therefore, that those shes in a plantation which are bearing most heavily succumb much e most readily to attack by leaf disease. In fact overbearing may st make the difference between quite an insignificant attack by the ngus and a very severe one. Severe attack by leaf disease is almost variably followed by considerable dying back of the branches in the llowing season, but this is also a very frequent consequence of erbearing itself even where no leaf disease occurs. The obvious thod of avoiding losses due to overbearing is partial decropping of avily laden bushes but, since in Kenya the temptation to make y while the sun shines is about as great as elsewhere, overbearing an influence affecting the occurrence of disease might be considered much an economic as a cultural factor.

Having now traversed a range of problems connected with the idence of disease in Kenya, it may be interesting in conclusion to ation one which has been under investigation for a short time only. is concerns streak disease of maize which derives its name from its f symptom, which is the presence of white or yellowish streaks ich run parallel with the leaf veins and alternate with the normal n colour. This is associated with considerable dwarfing of the t and reduced yield. The nature of the disease and its method transmission were first described by Mr. Storey, the Natal ologist, about two or three years ago (3)* and (4). He showed it was of a virus type and conveyed from a diseased plant to a thy one through the agency of a leaf hopper. He also found that same disease occurs in sugar cane and certain wild grasses. In ya, however, different factors, which are as yet very imperfectly derstood, appear to be operating. The particular leaf hopper which ved to be the vector in Natal is not known to occur in Kenya and periments with other leaf hoppers have not yet been successful in ging about transmission of the disease. Moreover the disease has shown any inclination to spread from a maize plot to an mediately adjacent patch of sugar cane at the laboratories and it not yet been found on any local grasses. (NOTE: Since this paper streak disease has been found on sugar cane in Kenya.) estigations in Kenya are still in the early stages, but some very esting facts have been discovered. So far the disease appears be confined to the red soil of the Kyambu and Fort Hall districts.

* See list of references on page 220.

and it appears to increase in importance from negligible proportions at altitudes below 5,000 feet to a serious problem at about 6,000 feet. Attempts are therefore being made to find answers to such questions as the following:

What insect carries streak in Kenya?
What are its food plants?
Does it breed on maize or merely end its days on that host?
Does the insect thrive best at 6,000 feet or are its food plants limited in distribution to red soils at the altitudes indicated?

It is believed that answers to some of these questions may be forthcoming shortly but, since nothing definite is known at present, the methods of the writers of serial stories will be adopted and this paper will end in an atmosphere of profound mystery.

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(1) Butler, E. J. Fungi and Disease in Plants, page 473.

(2) Dowson, W. J. Some problems of economic biology in East Africa (Kenya Colony). Annals of Applied Biology, Vol. VIII., No. 2, August, 1921.

(3) Storey, H. H. Streak disease an infectious chlorosis of sugar cane, not identical with mosaic disease. Report of the Imperial Botanical Conference, London, July, 1924.

(4) Storey, H. H. The transmission of streak disease of maize by the leaf hopper *Balclutha mbila*, Naude. Annals of Applied Biology, Vol. XII., No. 4, November, 1925.

Mr. RITCHIE, in six years, had only found head smut on maize *(Ustilago reiliana)* on one occasion, but it occurred on both wild and cultivated Sorgums. The disease had not made much headway in Tanganyika, where the maize crop is grown under haphazard native conditions.

BACTERIUM MALVACEARUM, E.F.S.

Mr. McDONALD said that very little cotton was grown in Kenya, and this disease had never been sufficiently important for investigation.

BROWN BAST DISEASE OF *HEVEA*.

The Section regretted that it was not in a position to reply to this.

CHAPTER VI.

MISCELLANEOUS.

RECENT WORK IN THE CONTROL OF CUTWORMS.

It was agreed:

That the conditions and problems in South Africa are so entirely different from those in the tropical East African Colonies, that the problem is one for solution in the various territories concerned.

COMPILATION OF LISTS OF INJURIOUS INSECTS.

Mr. ANDERSON explained that this question had been brought up by the Kenya Agricultural Department, as it was felt that a compilation, in the various territories, of injurious insects would be of great benefit. He thought that it would be advisable that the pests should be enumerated under the host plants and also systematically.

After some discussion, the following resolution was agreed to for ference to the main Conference:—

(1) That each participating Territory should arrange to prepare lists of injurious insects, with their food-plants and status as pests, and to interchange such lists.

(2) That, in order that the lists may be uniform, they should be compiled in the following form: (a) Name, (b) Reference to original description, (c) distribution, (d) food-plants and alternative hosts, (e) status as a pest, (f) predators and parasites, (g) further notes.

The question was further considered at a joint meeting of the gricultural, Entomological, and Mycological Sections.

Mr. HOLM thought that the lists should comprise fungoid seases as well as injurious insects.

The Conference approved this suggestion.

Miss WELSFORD said that a list of fungoid diseases had been rtly prepared at the Bureau of Mycology, and if the Bureau were proached it would probably be prepared to undertake the work.

Mr. HOLM considered that it was the proper duty of the Bureau Entomology and the Bureau of Mycology in London to carry out work of editing and publishing the lists when received from rious Territories.

It was agreed that the conclusions which had been approved by Entomological and Mycological Section should be endorsed, with e addition of a rider to the effect:—

That the Bureau of Entomology and the Bureau of Mycology in London should be approached with a view to the compilation and classification of the lists by them.

NOTIFICATION OF PESTS.

(Dealt with at full meeting of all Sections.)

The CHAIRMAN read the note by Mr. H. C. Sampson (T.C.(C) p. 3).*

Mr. KIRBY stated:

(1) That paragraph 3 of the paper evidently referred to a recent currence in regard to cotton-growing in the Rungwe district anganyika) and Northern Nyasaland.

(2) That there was no outbreak of any cotton pest in Rungwe.

(3) That cotton-growing by natives was encouraged by the offers Vua ginnery, Nyasaland, for seed-cotton, and by the local ministration.

(4) That the Entomologist, Nyasaland, made the requisite servations in connection with the matter in the ordinary course of duties.

* For text of this note see Appendix.

(5) That, as a result of his representations, cotton-growing has been forbidden by the Governments concerned in each of the areas in question.

On the suggestion of Mr. Holm it was agreed:

That each Department of Agriculture in South and East African territories should undertake to notify, without delay, every other such Department of the presence of a new disease or pest considered to be of economic importance.

THE USE OF LOCAL INDIGENOUS PLANTS AS INSECTICIDES AND FUNGICIDES.

Mr. SMEE asked whether other delegates had had any experience in this connection.

No information was forthcoming on this point, but the Section was of opinion:

That a study should be made of the insecticidal properties of native plants.

METHODS OF STORAGE OF NATIVE FOOD PRODUCTS.

(Dealt with at joint meeting of Agricultural, Entomological, and Mycological Sections.)

Mr. KIRBY had placed this item on the Agenda as he thought that every effort should be made to assist natives in their methods of storage, in order to provide against famine. He asked Mr. Ritchie to explain the details.

Mr. RITCHIE read the following notes: Observations show that in Tanganyika the types of grain grown by the natives show a considerable resistance to attack by storage insects.

In the Sorghums *(Andropogon sorghum)* the types grown fall into two classes, *i.e.*, hard (with glumes not appressed to the grain) and soft (with glumes appressed to the grain). The latter are poor keepers and are grown by tribes living in round dwellings, with a grain store in the upper part of the dwelling. The smoke and heat of the cooking fire below keeps the grain in condition. The hard grains keep almost indefinitely and are in especial favour by the Swahili, who has not the former means of maintaining the soft grain free from insects. Hard Sorghum is stored in wattle and daub barrels. These hard Sorghums, however, are more susceptible to head-smuts than the soft types, and take from six to seven months to come to maturity. Such quick maturing Sorghums as have been on trial, while maturing in from three to four months and showing resistance to head-smut, are very soft in grain and are quickly destroyed in storage by grain moth and grain weevil. They are also more susceptible to leaf-rust *(Puccinia purpurea)* than local types. There is a problem here for the plant breeder.

The type of Bulrush Millet *(Pennisetum typhordeum)* grown in the Territory, when thoroughly sun dried and freed of adhering chaff, keeps extremely well in the same type of wattle and daub barrel. When, however, the grain is of uneven size, and not well cleaned,

ıff is worked into the grain mass; the natural ventilation of the ıin mass fails and a mustiness is set up which attracts moth and evil. Introduced types from India on trial, while bolder and of ıferable colour, lack this hardness so important in storage.

Rice, so long as it is stored as paddy (unhulled) defied the rice evil. Long, narrow bags made from palm fibre are used. The ses in rice occur in the Indian dukas, where the cleaned rice is red in sacks to await the rise in market.

Maize is stored in the shuck, hung up in various manners in the en. It is essential that maize for the native should have a long nted shuck-covering, completely protecting the cob. If this is ıe this method of storage is highly successful. Introduced varieties ımaize generally show a high percentage of cobs with tip protruding; ɔreover, they have a softer, starchier grain, which is attractive to weevil, and on this account the native is not inclined to grow em. He wants a medium grain, hard maize, well covered.

The storage of legumes is in a less satisfactory state. These are ıerally stored, in various types of receptacles, in the pod. After elling, weevil quickly takes the grain. Trials have been made of *ıum arvense* and the black *Phaseolus radiatus*, which have been ınd more resistant to bean weevil in India. Definite results cannot be reported, but the black *Phaseolus* promises well.

Mr. SIMPSON stated that *Eleusine* grain was the grain which s relied upon in Uganda for storage against famine years.

Mr. RITCHIE said that Bulrush millet had equally good keeping ɔperties. *Eleusine* in Tanganyika Territory was grown purely as a pombe "crop.

CHAPTER VII.

LEGISLATIVE MEASURES.

(Discussed at Joint Meeting of Agricultural, Entomological, and Mycological Sections.)

ɔVENTION OF THE INTRODUCTION OF THE CODLING MOTH THROUGH IMPORTS OF FRESH FRUIT.

Mr. ANDERSON explained that apples had been imported into ıya from South Africa for some considerable time, but that ently some doubt had been expressed as to the wisdom of this ort owing to the danger of introducing Codling Moth. He quoted acts from correspondence from the Department of Agriculture of Union of South Africa, which expressed the opinion that there ıld always be a slight danger of introducing the pest, in spite of l examination of imports. He stated that there was no Codling th in Kenya at present; and that if apples and pears were hibited it would also be necessary to prohibit plums and all other wn hosts. On the other hand, apples and pears had been imported

for some time, and there had so far been no record of the introduction of the pest, and it was merely a question of whether Kenya could afford to take the risk: the Colony could not at present provide such fruit in sufficient quantity, and the prohibition of import would mean that inhabitants would be debarred from obtaining such fruit supplies.

In reply to Mr. Fuller, Mr. Anderson further stated that he did not consider that Kenya would be on any safer ground by importing fruit from countries other than South Africa.

Mr. HOLM suggested that the proposal to prohibit should be considered in its wider application and not confined to South Africa, as, having regard to the widespread nature of Codling Moth, it meant, in effect, that no fruit, such as apples, pears, walnuts, etc., would be imported from any country. The imports of such fruit in 1925 were about £500 worth, and the import is being about doubled for the current year.

The CHAIRMAN (Mr. Fuller) said that there was no more reason for prohibiting fruit from South Africa than there would be from any other territory, and possibly the safest course for Kenya would be to limit the importation of such fruit from South Africa, and to frame regulations to ensure a more rigid inspection.

In reply to Mr. Holm, Mr. Fuller stated that he thought that exporters in South Africa would be able to give the necessary guarantee of freedom from the pest; and that, in order to expand their trade with Kenya, the South African Department of Agriculture would be willing to take measures of inspection in addition to those in force in the ordinary way.

In regard to the danger of the introduction of the pest by passengers, the procedure in South Africa could be adopted and a declaration demanded of the passenger that he was not in possession of any apples, pears, etc., with heavy penalties attached. He thought that by such measures the danger of the introduction of the pest would be reduced to a minimum.

Mr. HOLM asked for an expression of opinion from entomologists as to whether Kenya could hope, even with prohibitive legislative measures, to keep free of the Codling Moth in view of the fact that the pest had spread to nearly all apple growing countries.

Mr. RITCHIE thought that provided all known hosts were excluded, the only possibility of the introduction of the pest would be through packing cases which had been in the vicinity of fruit packing houses; introduction by this means was just possible but extremely improbable.

Mr. HOLM thought that, provided that the Department of Agriculture in South Africa found themselves able to carry out a special inspection for Codling Moth, and given the necessary certificate as had been suggested by the Chairman, the import of fruit into Kenya should not be prohibited.

Mr. ANDERSON thought that a further inspection at Kilindini would still be necessary.

The CHAIRMAN (Mr. Fuller) did not think that it would be difficult to have fruit consigned to Kenya specially inspected by entomologists at places of export in South Africa; and he undertook,

his return to South Africa, to ascertain what action the Union vernment would be able to take and to inform the Agricultural partment of Kenya what measures would be possible.

In this connection, Mr. Holm stated that he would write officially the South African Department of Agriculture, informing them that s question had been brought up by the Conference and that he had ed Mr. Fuller to make further enquiries on his return.

Mr. HOLM observed that even if special regulations were roduced to prevent the spread of Codling Moth to Kenya, there uld seem to be a possibility, if similar regulations were not in force Tanganyika, that the Codling Moth might be introduced via nganyika. He would like the opinion of the entomologists as to the ssibility of the moth establishing itself in Tanganyika on native nts and then spreading to Kenya.

It was generally thought by the Conference that such spread uld be improbable but that it was impossible to be definite on this int until more information was available as to the host plants: so , no instance of Codling Moth on native vegetation had been corded.

Mr. KIRKPATRICK expressed the view that the probability of veloping an export trade in apples from Kenya should be the ciding factor in this discussion. If such export were probable, the k of introduction of the pest was not justified and importation ould be prohibited. If, on the other hand, it were improbable that export trade would be established, it was not fair to the present neration to deprive them of such fruit.

It was generally thought by the Conference that there were spects of an apple industry being established in certain areas in nya; such being the case, every precaution should be taken to nimise the risk of the introduction of the Codling Moth.

MEASURES SUGGESTED FOR THE PREVENTION AND SPREAD OF PLANT DISEASES.

Mr. VAN DEN ABEELE said that, in order to prevent the ad of plant diseases, it appeared desirable that the transport of from one Colony to another, or even from one part of a Colony nother part, should be so regulated as to make examination and haps disinfection obligatory under the control of a competent ice of the country of origin, whose certificate, valid for three nths, should be attached to each invoice.

He suggested that the Conference might discuss the methods of nfection, and make suggestions for the different botanical species tton, maize, etc.) It was most important that all kinds of seeds uld, on importation, be examined by the special service of the porting country, and that the results of investigation should be mmunicated to the country of origin, together with any enquiries ich might be necessary. (*Platyedra gossypiella* was recently found cotton seed imported from Egypt.)

(The above was circulated as a note under T.C.(C)Ag.20.)

Mr. FULLER thought that no efficient method of protection ld be evolved by means of certificates from the exporting countries. m experience in South Africa he had no faith in any certificates

which were signed by exporting countries. No doubt all these certificates were signed in good faith, but he thought that it should be agreed that every country must protect itself and must make its own regulations to prevent the entrance of pests.

Mr. HARDENBERG stated that from experience he must agree with Mr. Fuller's view.

Mr. HOLM said that the first precautionary measure that any country should take in this matter was to introduce the permit system.

LEGISLATIVE MEASURES IN THE CONTROL OF INSECT PESTS AND PLANT DISEASE.

Mr. ANDERSON read certain extracts from his paper* and was of the opinion that uniform action, if possible, should be taken by the East African territories in the drafting and enforcing of regulations governing:—

(a) Importation of plants.
(b) Plantation inspection.
(c) Plant quarantine.
(d) Nursery inspection.

All Directors of Agriculture present agreed to take such action as was possible on these lines.

It was agreed:

That uniform legislation should apply to importation of plants and seeds into Kenya and Uganda.

CHAPTER VIII.

SUMMARY OF CONCLUSIONS OF ENTOMOLOGICAL & MYCOLOGICAL SECTION.

COTTON PESTS.

1. That the *Platyedra erebodoxa*, Meyr (M. S.), discovered by Mr. Hancock, shows no indication of becoming a pest of cotton in Uganda.

2. (a) That steps be taken to secure from each African territory a report upon the presence or absence of Pink Boll Worm therein, together with a carefully prepared map showing the different cotton growing districts; and, if Pink Boll Worm is present, the areas known to be infested.

(b) That, from the information so supplied, a map of Africa be prepared for the use of African Entomologists, showing the distribution of cotton cultivation and of Pink Boll Worm.

(c) That the delegation from South Africa, as represented by the Government officials and the officials of the Empire Cotton Growing Corporation, be asked to initiate this project and secure the publication in South Africa of the desired map for distribution.

* T.C.(C)E. & M.1.) For text of paper see Appendix.

3. That, although a great deal of experimental and investigational work has been done on Sudan, American, and Spiny Boll Worm, this Section is not in a position to make any general recommendations. No economic means of control have yet been devised, but the Section is of opinion that further investigations are desirable and necessary.

4. That there is danger of *Apion* becoming a serious pest if burning is not resorted to, and that in Tanganyika burning and burning has been found to be entirely successful.

5. That the status of the wild food plants of the Sudan Boll Worm is of great importance and calls for further thorough investigation.

6. That the control of *Aphids* and *Jassids* by fungi should be further investigated.

7. That a wider survey is necessary before any definite information can be supplied in regard to the natural occurrence of major pests, and their occurrence under conditions of cultivation.

8. That, in view of the immense importance of Cotton Staining and Internal Boll-rots to the future development of Cotton growing in Africa, it is recommended:—

(a) That thorough investigations should be undertaken into the problem, with special reference to the possible role played in transmission by *Dysdercus* and other suctorial insects.

(b) That in some one centre an adequate staff should investigate thoroughly the whole problem in all its aspects, and that the Government of South Africa should be approached, in the first instance, with a view to undertaking this work.

(c) That the programme of the work to be adopted should be drafted by the staff of the centre chosen for the major investigations.

(d) That this programme should be circulated to the Departments of Agriculture in other Cotton growing areas, with a view to complementary work being undertaken by them.

GENERAL ENTOMOLOGY AND MYCOLOGY.

9. That much more work should be done by Entomologists in regard to the *Pheidole* ant, and that the question of baits and the destruction of nests is worthy of close investigation. As this ant was of great importance in Kenya, it was recommended that a thorough investigation should be undertaken in Kenya.

10. That the Entomologists of Kenya and Uganda should meet and discuss the question of preventing the spread of *Stephanoderes hampei* into Kenya after visiting Coffee areas to the east and west of Mount Elgon.

11. That the conditions and problems in South Africa are so entirely different from those in the tropical East African Colonies that the problem of the control of Cut-worms is one for solution in the various territories concerned.

12. (a) That each participating territory should arrange to prepare lists of injurious insects and fungoid diseases, with their food plants and status as pests, and to interchange such lists.

(b) That, in order that the lists may be uniform, they should be compiled in the following form:—

(a) Name, (b) Reference to original description, (c) Distribution, (d) Food plants and alternative hosts, (e) Status as a pest, (f) Predators and parasites, (g) Further notes.

(c) That the Imperial Bureau of Entomology and Imperial Bureau of Mycology in London should be approached with a view to the compilation, classification and publication of the lists by them.

13. That each Department of Agriculture of South and East African Territories should undertake to notify, without delay, every other such Department of the presence of a new disease or pest considered to be of economic importance.

14. That a study should be made of the insecticidal properties of native plants.

15. That uniform legislation should apply to importation of plants and seeds into Kenya and Uganda.

ENCLOSURE TO PART IV. ENTOMOLOGY AND MYCOLOGY.

Record of Proceedings in the Entomological and Mycological Section in regard to Cotton Pests.

PINK BOLL WORM.

Mr. HARGREAVES read the following paper which had been prepared by Mr. Hancock in regard to Pink Boll Worm occurring on *Hibiscus diversifolius* (referred to in agenda as T.C.(C)E. & M.4):

This note is to draw attention to the occurrence in Uganda of a species of *Platyedra* closely related to *P. gossypiella*, Saund, which has been found feeding on a wild species of *Hibiscus*, namely *H. diversifolius*.

Specimens of this insect, which are exhibited here, have been examined by Mr. Meyrick who considers them to be identical with *Platyedra gossypiella*, Saund, the pink boll-worm of cotton.

In view of the fact that this insect does not feed on cotton in the field and that the arrangement of the crochets on the prolegs of the larva differs somewhat from that of the larva of the cotton feeding *Platyedra* it will be well to consider this form a distinct race or species of *Platyedra*. As you will see from the mounted specimen of the larva there is a distinct break in the horseshoe arrangement of the cotton-feeding form. This *Hibiscus*-feeding form is perhaps closely related to the species which are being described from Australia but at the time of writing neither specimens nor descriptions of these forms have been received.

There appears however little danger from this insect. A careful search has not revealed it on cotton nor has it been found in samples of cotton seed received from ginneries from all parts of Uganda.

In the laboratory a young larva was induced to feed in a young cotton boll, and having completed its metamorphosis, emerged as a perfect moth. It has so far not been possible to induce larvæ to eat full grown cotton bolls or to feed on cotton seed.

Perhaps the only economic justification for the study of this ect is to endeavour to ascertain if its natural enemies are likely to ve of any value against the true cotton feeding *Platyedra syppiella*, Saund, and some time is being devoted to this object. ther work, however, is still needed before it will be possible to ermine whether or no its insect enemies are of sufficient importance xport to countries where the pink boll-worm seriously damages the on crop. As the true cotton feeding *Platyedra gossypiella* does occur in Uganda, any experiments to test the efficacy of parasites he *Hibiscus*-feeding race must of necessity be made elsewhere.

It will suffice at present to state that parasites belonging to three era *Microbracon*, *? Chelonus*, and *? Apanteles* have been bred from seed capsules of *Hibiscus diversifolius* and the foremost species has n observed to feed as an external parasite on the *Platyedra* larva. e whole life cycle of the *Microbracon* occupies not more than 20 s, but it has not been found possible to induce it to oviposit in tivity, a difficulty which has been reported from America with *robracon mellitor*, Say, a parasite of *P. gossypiella* on that tinent.*

It is hoped that sufficient data will have been collected to publish hort account of this insect next year. Specimens of the parasites ntioned above are exhibited here and any information which you y be able to give concerning the species of parasites which attack *tyedra* in your countries will be very welcome.

(Note.—Subsequent to the reading of the above paper, informa- was received to the effect that Mr. Meyrick had agreed to separate *Platyedra* on *Hibiscus* from that occurring in cotton as a distinct new species for which he proposed the name *P. erebodoxa.)*

Mr. RITCHIE stated that he had not as yet had an opportunity visiting the Tanganyika area bordering on Uganda, in the neighbour- d of the Kagera River, near which Mr. Hancock found the *yedra* which formed the subject of his paper, but that he proposed he near future to make a survey of all that country. There was interesting point in this connection in Tanganyika, namely, that of the most important of the parasites of *Platyedra* was not found otton but on okra *(Hibiscus esculentis)*.

Mr. HARGREAVES thought that possibly that form of *Platyedra* he one which had been described as being found on *Hibiscus*.

Mr. RITCHIE said that as far as he knew, cotton and okra were only hosts for *Platyedra* in Tanganyika Territory. In okra tion takes place nearly always in the pod, but in cotton it seems ke place only in the soil.

Some discussion then took place as to the possibility of the new *yedra* found in Uganda becoming a cotton pest, and Mr. reaves stated that in Queensland both the *Hibiscus* and the cotton ns are found, and that the *Hibiscus* form does not attack cotton. also stated that cotton was growing in the vicinity of the e in which the *Platyedra* was found in Uganda, and that it was being attacked by it.

After further discussion it was agreed that the following conclusion ld be presented to the general Conference on this subject:—

That the *Platyedra erebodoxa* discovered by Mr. Hancock shows no indication of becoming a pest of cotton in Uganda.

* U.S. Dept. Ag. Bull. 1374 (March, 1926).

Questions having been asked as to the names of authorities i Africa to whom reference might be made in the identification of suc pests, Mr. Fuller promised to prepare a list of specialists in variou groups, for the information of the members of the Conference, an said that he would ask Mr. Hardenberg to assist him in th compilation.

The question asked by the Agricultural Department, Uganda, i regard to distribution of Pink Boll Worm in Tanganyika was the raised.

Mr. RITCHIE stated that there were two areas in Tanganyik Territory, near the Uganda border, in which cotton was grown namely, Bukoba and Mwanza. These areas were not infested wit Pink Boll Worm and there was no connection between them an other areas in Tanganyika Territory in which Pink Boll Worm ha been found. In their own interests, the Tanganyika Government wa making every endeavour to prevent the spread of this pest to th Bukoba and Mwanza areas, and there appeared to be every probabilit that the measures taken to this end would be effective, as there wa a buffer zone between the two areas—some 200 miles of barren countr —clear of cotton.

For the information of the Uganda Government, Mr. Ritchie mad the definite statement that Tanganyika is endeavouring to prevent th spread of Pink Boll Worm of Cotton from the infested area of th coast and central region to the clean areas of Bukoba and Mwanza which are adjacent to Uganda.

Mr. RITCHIE stated that in Tanganyika, pupation took plac outside the boll, and twin seeding was not known to occur. Fumiga tion, according to Loftin's formula, was completely successful. Fo many years the Arabs had been growing Peruvian cotton along the ol slave routes, and it was extremely difficult to make them destro these trees, the cotton from which had been used in the ritual for th dead from time immemorial. These trees were, in some cases infected with Pink Boll Worm.

Mr. ANDERSON stated that there was no record of Pink Bol Worm in Kenya. The seed for cotton grown on the coast wa imported from Egypt, and that for Kavirondo cotton from Uganda.

The following conclusion was agreed to:—

(a) That steps be taken to secure from each African territor a report upon the presence or absence of Pink Boll Worm therein together with a carefully prepared map showing the differen cotton growing districts; and, if Pink Boll Worm is present, th areas known to be infested.

(b) That, from the information so supplied, a map of Afric be prepared for the use of African entomologists, showing th distribution of cotton cultivation and of Pink Boll Worm.

(c) That the delegates from South Africa, as represented b the Government officials and the officials of the Empire Cotto Growing Corporation, be asked to initiate this project and secure the publication in South Africa of the desired map fo distribution.

Arising out of some remarks by Mr. Ritchie, Mr. Fuller observed it there seemed to be a distinct danger of the spread of Pink Boll orm from ginneries, and suggested that this question should be ther discussed with the Cotton representatives in connection with m 5 of Category III. of the Agenda.

EVENTION OF INTRODUCTION OF PESTS AND DISEASES.

The question of the adequacy of present methods of disinfection a safeguard against the introduction of pests and diseases was then cussed.

Mr. HARDENBERG said that, in Portuguese East Africa, they re not satisfied with the regulations in regard to the importation of ton seed as to whether they were entirely effective in preventing entry of Pink Boll Worm. Personally, he put no faith in the at treatment of cotton seed and based his opinion on his experience h a parcel of 5lbs. of cotton seed, which was being imported into urenco Marques from Egypt via Liverpool. This seed was said to ve been subjected to the heat treatment before leaving Egypt and in disinfected before despatch from England. Nevertheless, upon ival it was found to contain a very considerable number of live væ and pupæ of the Pink Boll Worm, while between the outer and er wrappings several specimens of the adult were found bsequently determined by Dr. Janse in Pretoria as *Platyedra sypiella)*. He had also tried the treatment of cotton seed by the phuric acid process, and this method appeared to be more isfactory than that of fumigation, although he was not satisfied it was entirely successful, as in the twin seed stage sulphuric acid ght not penetrate the silky covering.

Mr. KIRKPATRICK said that climatic conditions affect twin ding, which is a feature of those countries only that have a finite cold season.

CONTROL OF BOLL WORMS.

The Section then considered the questions on the value of control Boll Worms asked by the Empire Cotton Growing Corporation enda, Category VII., item 6), and agreed to submit the following ervations in respect of Pink Boll Worm to the Combined Cotton Entomological Conference:—

(a) *Control by Natural Enemies.* There is no effective control by natural enemies. In Egypt one of the parasites present, *Pimpla Roborator*, does become common at the end of the season; and it is more than likely than by a thorough knowledge of its bionomics its numbers could be increased early in the year, thus checking the rapid increase in the boll worm population. But it can definitely be stated that, without a great deal of research, nothing much can be expected from natural enemies.

(b) and (i) *Elimination of Food Plants.* While recognising that further work is essential in the determination of native host plants, it can be stated that the value of the elimination of alternative food plants depends on the life-history of the boll worm in any given country, which is determined by the climate. In countries with a definite winter, where cotton is a summer crop, the Pink Boll Worm spends the winter

as a resting-larva, usually in a " double seed," *i.e.*, two or more half eaten seeds spun together. Under such conditions it is these resting larvæ in the numerous old bolls that fall to the ground and escape destruction, which carry on the race to the following year; and the elimination of alternative food plants, which probably means nearly or quite all Malvaceous plants, would probably not be economically worth while. But when there is no definite winter, and the boll worm breeds continuously throughout the year in a succession of short-cycle generations, the destruction of alternative food-plants, in combination with a close season for cotton, is absolutely essential; the moths emerging at the end of the cotton season will then find nowhere to lay their eggs, and as the larvæ are unable on account of the climate to assume the long-cycle condition, a fair measure of control should be assured by these methods alone.

(c) and (d) *Implemental cultivation and rotations.* While recognising that it might be worth while to experiment with a view to ascertaining whether sustained submersion by irrigation would be of value, it can be stated that the only information on implemental cultivation and rotations is applicable only to countries where the Pink Boll Worm undergoes a resting period, and mainly to places where cotton is grown by irrigation. The experiments of Williams and Bishara, in Egypt, conclusively proved that the greater the depth the bolls containing the resting larvæ were buried the fewer survived; the survival at 30 cms. being nil. Secondly, the wetter the land was kept during the winter, the fewer were the survivals next spring; consequently, Bersim (Egyptian clover), which is frequently irrigated, is a much more suitable crop to follow cotton than the usual alternative in Egypt, namely, wheat, which receives much less water. But where cotton is grown under rainfall conditions and in countries where the resting stage larva of the Pink Boll Worm does not occur, it does not seem likely that rotations would have any effect one way or the other.

(e) *Spraying and Dusting.* From the nature of the life history of the Pink Boll Worm it cannot be attacked by spraying or dusting. It is just possible that if the adult moth (as do many other moths) drinks dew, the dew might be poisoned by a calcium arsenate dusting, but it seems unlikely that this would be a practicable means of control.

(f) *Trapping, Adults.* The Pink Boll Worm (in spite of numerous statements to the contrary) is readily attracted to light. Willcocks in Egypt caught 19,000 moths with 18 traps in an acre of cotton in three months, but although the infestation was somewhat less in the trapped plots than in the controlled ones, he did not consider the use of light traps an economical measure.

No information is available in regard to trapping by bait.

(g) and (h) *Hand-picking or collecting Larvæ in the Field, and Trap-cropping.* These methods are considered to be impracticable.

PINK BOLL WORMS. ALTERNATIVE FOOD-PLANTS.

Mr. RITCHIE stated that as far as was known, the only rnative food-plant in Tanganyika was okra *(H. esculentus)*.

Mr. KIRKPATRICK said that in Egypt the known alternative l plants were *Hibiscus esculentus*, *Hibiscus cannabinus*, holly- ks and, possibly, other *Malvaceæ*, but more research on these s was necessary.

It was agreed:—

That the whole question of alternative food-plants was uncertain and open to investigation.

APION.

BARON SURCOUF read the following paper on *Apion Armipes* ferred to in the Agenda as T.C.(C)E.& M.7):—

In September, 1925, I inspected the cotton crops in the district Zambezia. One of the pests noticed was *Apion armipes*, Wagner, ich occurred chiefly on cotton cultivated by natives, though it s also abundant on cotton grown under the direct control of the zambique Industrial and Commercial Company.

The damage caused by this species was considerable, hundreds hectares of cotton bearing no crops of any appreciable value. e adult weevils are found in the cotton flowers, on the petals of ich they feed. The females oviposit on the axils of the leaves, ee or four eggs being laid at a time. The larvæ on hatching etrate the tissue of the young stem, in which they live. A rous plant, when attacked near the growing point, develops ndary growth in the neighbourhood of the attacked region; weak ts, however, die.

With the aid of a lens, it could be seen that many of the *on* larvæ were parasitised by a small Hymenopteron. The e of this parasite when full-fed, leave the dead *Apion* larva, and rge from the stem of the plant, on the outside of which they elongated white silk cocoons, of which there may be at least zen from each host larva.

By collecting these cocoons, I succeeded in obtaining about living parasites which were liberated in the district of Canchiche, the result that the *Apion* in that neighbourhood almost completely peared.

In my opinion the best methods to be employed for the control e *Apion* are the breeding and liberation of this parasite; and destruction of the alternative host plants of the *Apion* in the nity of cotton plantations.

BARON SURCOUF stated that he had found thousands of *n* on cotton in Portuguese East Africa, but had not discovered n any other plant.

Mr. SMEE said that *Apion* was determined in Nyasaland t 1909, when it was reported to have been serious. It was still ent there but he had not noticed that it did much damage to n, as it appeared late in the season and the damage done was ligible.

Mr. RITCHIE said that *Apion xanthostylum* was found in Tanganyika but only in the Morogoro area. The first generation attacked the base of the young cotton and might kill the plants. Further generations breed at the junction of the branches and under the boll, causing premature ripening and consequent weakening and shortening of the staple. Early in 1922 they realised *Apion* could be a serious potential pest on cotton, and 15% of the trees on the experimental station at Morogoro died early in the season from attack at the base. After that time strict measures were taken to ensure that all cotton was properly uprooted. *Apion* was still found but he had not regarded its effects as serious. Parasitism by a braconid was known but he would not rely on control by parasite. It had been found in Tanganyika that uprooting and burning was an entirely satisfactory method of dealing with the pest.

Mr. HARDENBERG from experience with this insect in the district of Quilimane, considered that *Apion* was a potential pest of very great importance; and was of the opinion that infestation in cotton plantations originated outside the cotton fields and gradually spread. He had noticed that some of the pupæ contained parasites but had no information as to their identification.

It was agreed that Baron Surcouf's paper should be incorporated in the Report, and that a statement should be added to the effect:—

> That there is danger of *Apion* becoming a serious pest if uprooting and burning is not resorted to, but that in Tanganyika uprooting and burning has been found to be entirely successful.

SUDAN BOLL WORM *(DIPAROPSIS CASTANEA.)*

DISTRIBUTION.

This pest has not yet been reported from Uganda (Hargreaves), Tanganyika (Ritchie), or Kenya (Anderson). It is a serious pest in Nyasaland (Smee), and in Portuguese East Africa (Hardenberg): it is also known to be present in the Belgian Congo: it occurs over the whole of the cotton areas in South Africa, except in parts of the Cape Province (Haines).

Mr. HARDENBERG said that in Mozambique it occurred where cotton was grown. It was a serious pest and the worst on cotton, and was responsible for 80% of loss of crop.

Mr. SMEE stated that it was widely distributed in Nyasaland, where it was the most serious pest and the main limitation of cotton culture.

Mr. RITCHIE said that one record was extant from Tanganyika: this was from the extreme southern corner of the Territory, bordering on Nyasaland, in 1925 when cotton growing was attempted there for the first time since the war.

WILD FOOD-PLANTS.

Mr. HAINES (contributed). The Sudan Boll Worm is found on cultivated cotton and wild cotton *(Gossypium* spp.) and on a wild *Malvaceous* plant (sp. undet.). This last food-plant was found by F. S. Parsons at Magut, Zululand.

Mr. SMEE said that in Nyasaland it had only been found on cotton, except for one record on *Thespesia*.

Mr. HARDENBERG said that it had been suggested that larvæ ht breed in the roots of the sweet thorn, and that investigations in direction should be made.

The Section considered—

That the study of the wild food-plants of the Sudan Boll Worm is of great importance, and calls for further thorough investigation.

LUE OF CONTROL OF BOLL WORMS OTHER THAN PINK BOLL WORM.

BARON SURCOUF had found many parasites of the boll worm Portuguese East Africa.

Mr. SMEE said that parasites were unknown in Nyasaland.

Mr. RITCHIE said that in Tanganyika Territory only one eration of *Chloridea* was known to occur on cotton bolls annually. bsequent to June the crop was free from *Chloridea*.

Mr. SMEE said that in Nyasaland tobacco was first attacked, and en the tobacco crop was harvested the *Chloridea* passed on to the ton.

The Chairman read the following notes contributed by Mr. ines:—

DAN BOLLWORM.

Two egg parasites (spp. undet.) have been reared but only 5 or of the eggs examined were parasitized.

Two larval parasites (spp. undet.), a *Tachinid* and a *Braconid* (?) e also reared.

I have also found pupæ containing exit holes of parasites, but no imens have been reared.

At least three or four species of wasps have been found actively ged on larva-hunts in cotton fields and they have been observed atch bollworm larvæ.

A *Pentatomid* bug, *Glypsus conspicuous*, has been observed ing out larvæ of this bollworm.

RICAN BOLLWORM.

Two egg parasites have been reared, and late in the season the entage of parasitism may run as high as 50%.

One *Tachinid* larval parasite has been reared. The same lators, as mentioned above, have been observed preying on this orm.

IAS INSULANA.

Two *hymenopterous* larval parasites have been reared. Parasitism been very heavy in some instances, and at times appears to give tive control.

The value of control by natural enemies (including parasites) has been lost sight of; but, except for the American and spiny boll- ms in a few cases, efficient control does not seem to obtain in re. These enemies and parasites have been sent to London for rmination. Further studies will be made, both as to species

concerned and percentage of parasitism. It has been found that bollworm parasites often attack species of leaf-feeders as well, *e.g.*, *Cosmophila aurigoides*. The mortality of pupæ in the soil is often very high, but how much is due to enemies or parasitism has not yet been determined.

Elimination of Food-Plants.

Control by this means has not been attempted. It would be impossible for the American bollworm since this species' food-plants are multitudinous and would be difficult for the spiny boll-worm, since wild malvaceous plants are so numerous and so widespread in South Africa. As for the Sudan bollworm, it would be impracticable to attempt elimination of its food-plants until we know with more certainty what these are. To my mind, it is questionable whether complete elimination of all food-plants of the Sudan bollworm would solve the problem. We have not yet found an effective remedy for this pest in the cotton fields; and until one is found these fields act as reservoirs, which are as dangerous as the reservoirs in nature.

Implemental Cultivation.

No data is, at present, available as to exactly how effective this method of control is, as it is extremely difficult to check up accurately the results of any given cultural method. It is my opinion that a careful study of this method of control should be made, if a satisfactory way of checking up results can be found. It certainly does not seem to be impossible to find a method of cultural operations, perhaps combined with a close season and rotations, which would help to check the bollworm pest.

Rotations.

I have no statement to make on this method of control. However, I think it a very important factor in bollworm control, especially in conjunction with implemental cultivation and a close season.

Spraying and Dusting.

Both sprayings and dustings with lead arsenate, calcium arsenate, Paris green, calcium cyanide, sodium fluosilicate, and Bordeaux mixture have been tried very extensively at various times during the past seven years: and all, except Bordeaux mixture, have given negative results. Last season's experiments with calcium arsenate dust gave absolutely negative results; in nearly every instance the controls gave more seed-cotton per acre than the treated plots, in application ranging from one to six. Also, the cost of treatment was considerable, in many cases absolutely prohibitive. With Bordeaux mixture, more promising results were obtained, but not promising enough to warrant recommendation. Increases in yield ranging from 30 to 250 lbs. of seed cotton per acre were obtained. It is certain that spraying and dusting, as it is done at present, is not a success. At present, it appears that our only hope for success lies with Bordeaux mixture, but much more must be learned first about method of application and effect on bollworm and other pests and on diseases. It is not yet clear exactly what effect Bordeaux mixture has on the bollworms alone. My several years experience with spraying and dusting for bollworm control has made me very doubtful that it will prove to be an effective remedy. Basing my statement on the data at present available, I can say most emphatically that I am not

epared to recommend this method of control. As a whole, the ults obtained have been most discouraging. I might add that our oratory experiments on the effect of calcium arsenate on the larvæ the Sudan bollworm seem to indicate that this poison has *no* effect, that the larvæ reject the poisoned rind of the cotton boll.

APPING ADULTS.

No experiments have been conducted along this line of insect ntrol. I certainly think that this method of control is worth serious nsideration. I have found that one female moth of the Sudan boll-rm lays nearly 500 eggs.

AND-PICKING AND COLLECTING LARVÆ IN THE FIELD.

An experiment on stripping the cotton plants, at a certain date en the infestation seemed to warrant it, of all squares and bolls fested and sound), and another similar experiment followed by a sting with calcium arsenate were conducted last season. The ults were negative in each case.

An experiment on picking the flared squares was also tried. This o gave negative results.

To find out what percentage of the flared squares contained live llworm larvæ, counts were made at a certain place last season. It s found that 31% of the bollworm-punctured flares (those fallen d on the plant) had live Sudan bollworm larvæ in them, that none ntained American bollworm larvæ, and that 1 or 2% contained væ of spiny bollworm. During cool or wet weather, a higher rcentage of live larvæ of the Sudan bollworm stayed in the flares. e mortality of larvæ in these fallen flares was not worked out but it s found that the larger larvæ could live for a considerable time in larger fallen bolls. With us, labour is too high to make this thod of control practical; and, in any case, it appears that the ults obtained do not warrant its use as a control measure.

AP CROPPING.

Only observations have been made on the use of maize as a -crop for the American bollworm. It has been noticed that, in e instances, American boll worm attacks on cotton have followed " hardening off " of the maize crop. No direct experiments have been conducted.

SE SEASON.

Few, if any, cotton growers in the Union of South Africa have npted to apply a strict close season to their programme in cotton ure. As a rule, it only occurs when brought on by frosts or when ings cease early in the winter. If connected with autumn or er ploughing, I think it would have a very beneficial effect. With a close season is so closely linked up with the establishing nting) of the following season's crop that it seems inadvisable to orce it at present. Hardships might be imposed unless the matter s carefully studied. However, in principle, I am in favour of a se season, and I think that the subject should receive careful study.

The following conclusion was adopted:—

That, although a great deal of experimental and investigational work has been done on Sudan, American, and Spiny Boll Worms, this Section is not in a position to make any general recommendation. No economic means of control have yet been devised, and we are of opinion that further investigations are desirable and necessary.

A NEW BOLL WORM.

Mr. Hargreaves related the occurrence in Uganda of a new boll-worm, *Argyroploce* sp.*

APHIDS AND JASSIDS.

The Chairman read notes† by Mr. Haines.

Mr. HARGREAVES stated that in Uganda the *Aphids* was perhaps the most serious pest on cotton; certainly the accumulated effect appeared to be greater than that of any other insect.

Mr. RITCHIE suggested that the control of *Aphids* and *Jassids* by fungi might be further investigated; a fungus was the most potent controlling factor of *Aphis* in Tanganyika, and he instanced the success of a fungus as the controlling factor of West Indian cane hopper, *Delphax sacchernora*.

This suggestion was accepted by the Section.

Mr. HARDENBERG was experimenting with nicotine dust and Bordeaux mixture in the control of *Jassids*.

OCCURRENCE OF MAJOR PESTS.

The Chairman read notes§ by Mr. Haines.

The Section accepted the position as put forward by Mr. Haines, and agreed:—

That a wider survey was necessary before any definite information could be supplied.

COTTON STAINER (*DYSDERCUS* SPP.)

The Chairman read the following paper (referred to in Agenda as T.C. (C)Cot.15), which had been submitted by the Southern Rhodesian Government:—

Two species of varieties of *Dysdercus*, namely *D. intermedius*, Dist. and *D. nigrofasciatus*, Stal. are extremely prevalent in their season in Southern Rhodesian cotton fields. It is clearly desirable that the relation of these abundant insects to the cotton crop should thoroughly be understood.

The economic status of an insect in any particular area must obviously be determined by local investigation, but experience in other areas is helpful in indicating a direction to such local research. In consulting available literature, some difference of opinion in respect to these insects in different cotton growing countries is apparent.

It is desired to make it clear at the outset that the present writer is wholly concerned in seeking information and has nothing in the way of experimental results to impart. His object is merely to place certain difficulties before the Conference and if possible to obtain an answer to one or two questions.

The genus *Dysdercus* appears to be of almost universal occurrence in the tropics and is apparently represented by one or other of its species in practically all cotton growing countries. The different species seem to have quite similar habits and it appears permissible to deal with the genus as a unit.

* See also page 171.
† For text of these notes see page 173.
§ For text of these notes see page 172.

Dysdercus spp. have been credited with several different forms of
ry, one of which, namely direct staining of the lint with their
eta, is not now held to be of serious importance by any
stigator; there remain:—

(1) Transmission of Internal Boll Diseases;

(2) Causing shedding of young bolls without the intervention of disease;

(3) Inducing failure of the bolls to open normally;

(4) Injury to the young seeds resulting in failure of lint to develop normally.

(5) Injury to seeds affecting germination and impairing their commercial value for crushing.

Of the above the first would appear to be the most important.
rnal boll diseases, including lint staining, are prevalent in this
ny and if *Dysdercus* spp. is to be regarded, as the main cause
e insects must clearly be accorded a very prominent place amongst
on pests. Other sucking insects large enough to pierce the carpels
more or less negligible in numbers in comparison.

In carrying out investigations into the question of the trans-
sion of disease by insects, it is obviously helpful if an accurate
hod of identifying the disease is known. In the present instance,
ever, there appears to be some degree of uncertainty in this
nection.

It would appear first of all that one form of boll rot may be
rated at once from the others, namely that caused by *Bacillus*
acearum which has been shown definitely to be independent of
neous aid in obtaining entrance to the interior of the bolls.
ft Rot " caused by a species of *Phytophthora* would also appear
a specific and readily recognised disease (Nowell).

In Southern Rhodesia Mr. F. E. Eyles, Botanist and Mycologist,
ultural Department, records the following of bacteria and fungi,
h have been associated with boll rot elsewhere, namely:
domonas malvaccarum, Smith; *Bacillus gossypii*, Stedman; and
otrichum gossypii, Sout. (*Rhodesia Agricultural Journal*, June
p. 637). Of these *B. gossypii*, Stedman, has been found in
ation with Bollrot, and *Colletotrichum* with compaction and
louration of lint in Southern Rhodesia.

The careful experiments carried out by Nowell in the West Indies,
eroy and Golding in S. Nigeria, and Ballard and Holdaway in
asland, although implicating Dysdercus and other sucking insects
transmission of bollrot, afford comparatively little enlightenment
the specific organisms causing the disease. Marsh, however,
ars to have associated lint staining in Nyasaland tentatively with
atospora sp. A fungus of this genus was also isolated by Nowell
West Indies and he mentions that Bartlett apparently isolated
ilar fungus. Ballard and Holdaway, however, do not mention
genus amongst the fungi bred from samples of cotton in Queens-

In point of fact, the only genus of fungi associated with
llrot " in all countries, where these have been really studied,
s to be *Alternaria*.

We seem to be somewhat in the dark as to which of the fungi and bacteria are true wound parasites, and which merely saphrophutes although several can no doubt be relegated to the latter category. The position appears to be that there is a fungus and bacterial complex associated with certain forms of internal boll disease, distinct from the diseases caused by *Bacillus malvacearum* and *Phytophthora* (Soft Rot), and that so far experiment indicates that this complex is dependent upon a breach in the carpel to obtain access to the interior of the boll. The composition of the complex appears, however, to be far from uniform. Furthermore, no definite distinction appears to have been established between lint staining and obvious boll rot, and the two lesions are commonly described under the same heading.

All this is unsatisfactory in one particular, namely that it commonly leaves the investigator without a means of identifying a given form of staining or discoloration in a specific manner.

To give an example, the small plots of cotton at the Agricultural Experiment Station, Salisbury, show practically 100 per cent. stained lint this season, and on one at least of these plots, which has been under close observation, the agency of *Dysdercus* or other sucking insects large enough to pierce through the carpel may, it is thought, definitely be ruled out. Moreover, the stained bolls in most cases afford no indication whatsoever of any perforation of the carpel nor does the distribution of the stain show any relation to a hypothetical puncture. It is located at the bases of the locks, all of which are involved. The lint is adherent to the carpels at the base and a portion tends to remain behind when the lint is picked in the ordinary way. Apart from this the bolls have not opened properly, and most of the lint in the opened bolls remains compacted.

The crop has been very slow in maturing, the elevation at Salisbury being probably too high for successful cotton culture in most seasons. On general considerations one would be inclined to attribute the condition of the cotton to physiological causes, but the staining answers well to the description of this trouble as shown to be transmitted by *Dysdercus*. It is here that the lack of a means of specific identification of the disease transmitted by *Dysdercus* is felt. Reports throughout the Colony are to the effect that staining is extremely prevalent this season, and heavy losses are anticipated. *Dysdercus* spp. have certainly been very prevalent on many farms and in many cases have clearly attacked the stained bolls previous to opening. At the same time the season has been an abnormally wet one, and the plants have suffered to a considerable extent on this account. In the light of experience at Salisbury caution appears to be indicated in attributing all this staining to *Dysdercus*.

It is also noted that Mr. H. C. Sampson in his report to the Empire Cotton Growing Corporation, 1922, describes lint staining in Nyasaland in a way which is in agreement with experience in Southern Rhodesia, and does not suggest *Dysdercus* as the cause in all cases. The influence of the season in reference to the trouble is also emphasized by Mr. Sampson. Moreover, the connection between *Dysdercus* and boll diseases does not appear to be clearly recognised in the South African Union, if one may judge by Mr. G. C. Haines's paper read before the conference of entomologists at Pretoria last year. *Dysdercus* in point of fact has been regarded as a minor pest

otton in South Africa for some years (see occasional notes in the rnal of the Department of Agriculture.)

With regard to the other injuries attributed to *Dysdercus* it would interesting to obtain the opinion of the delegates concerning the ortance under field conditions of boll shedding due to stainer cture, failure of the bolls to open normally and loss of lint due to ry to the seed by the same insects. Injury to seeds, affecting nination, appears to be of considerable importance in Southern desia during the present season. The seeds become very hard and vel to a noticeable extent. Whether the injury is purely direct or ciated with the development of organisms has not yet been rtained. The market value of the seed for crushing purposes is ed to be very seriously impaired, and much of it will apparently unsaleable. It is thought that *Dysdercus* is responsible for this ry, but the question calls for investigation. It appears to have n generally noted that the first infestation of a cotton field with *dercus* develops with great rapidity, and is due to invasion by lts which have matured elsewhere. Notes concerning the stage levelopment of the crop when this invasion takes place are not gether in agreement. Thus Pomeroy and Golding in Nigeria state the invasion commences as soon as the plants flower (R.A.E. ., p. 67). Withycombe in Trinidad states that the stainers erally appear when the bolls are ripening and not before (R.A.E. ., p. 548) and, elsewhere, that they are not attracted to the cotton s in appreciable numbers until the bolls commence to open (Bull. . Res., XV., p. 171). Observations in Southern Rhodesia to date generally in accordance with the last two statements.

Heavy shedding of the very young bolls, of course, commonly s place previous to heavy invasion of the fields by *Dysdercus*. shedding appears to be due to physiological causes, possibly of ilar nature to those causing the well-known " June Drop " of es in California, a phenomenon which occurs also in Southern esia in the corresponding season. Shedding due to *Dysdercus* k must clearly occur at a later stage and the experience of the ates as to its regular occurrence or otherwise, following the *ercus* invasion, and its economic significance would be instructive.

The points on which an expression of opinion by the Conference ld be specially appreciated include the following:

1. Have any of the delegates any experience of lint-staining occurring under conditions where the agency of *Dysdercus*, or of other sucking insects, is not indicated?

2. Have any of the delegates any experience of lint-staining which is apparently not due to either Bacteria or Fungi?

3. Are any extensive outbreaks of bollrot, due to *Bacillus malvaccarum*, Smith, in American " Upland " varieties on record?

4. What is the present position in reference to the association of *Bacillus gossypii*, Stedman, with Bollrot?

5. Have any careful mycological studies been made of bollrot and lint-staining *as occurring in Africa*, apart from Marsh's work on stained Nyasaland cotton?

6. Is there any experience on a practical scale elsewhere than in the West Indies, indicating clearly that control of *Dysdercus* suffices for the control of internal boll diseases?
7. Is there any experience to the contrary?
8. Have any of the delegates any experience of serious shedding of young bolls in the field clearly attributable to invasion by *Dysdercus?*
9. Have such troubles as irregular development of lint in the bolls and failure of the latter to open normally been noted as of serious importance in the field? If so, have these troubles been traced definitely to the agency of *Dysdercus?*
10. Has *Dysdercus* been associated anywhere with injury to cotton seed on such a scale as seriously to affect the quantity of suitable seed available for sowing, and to render a large proportion of the seed useless for crushing?

The CHAIRMAN (Mr. Fuller) stated that he was in considerable sympathy with the paper, as he thought that *Dysdercus* got the blame for staining, for which it was not responsible.

Mr. HAINES (contributed). In South Africa it is questionable how much lint-staining is caused by *Dysdercus* spp. We are more concerned, at present, in the part *Dysdercus* plays in the spreading of plant diseases, especially boll-rots. Since our attention has been given mainly to a study of the boll worms, we have little definite information in regard to stainers. Stainers fluctuate in abundance from year to year, and are rarely abundant until late in the season. A few years ago *Dysdercus superstitiosus* was common, but now *Dysdercus nigrofasciatus* and *Dysdercus fasciatus* appear to be the more common species. There appears to be considerable lint-staining due to infections following bollworm attacks.

After discussion it was agreed:

*That the status of suctorial insects in the spread of boll-rot requires much more investigation before any definite statements can be made. The problem is the more difficult, owing to the fact that the boll-rots have not yet been classified.

* Subsequently amended. See pages 172 and 178.

PART V.

GENERAL.

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PART V.
GENERAL.

(All items in this Part were discussed in full Conference.)

CHAPTER I.
REVIEW OF AGRICULTURE IN KENYA.

In full conference at opening meeting with His Excellency the President in the Chair.)

Mr. HOLM read the following paper (referred to in Agenda as .(C)Ag.18):—

The primary object of this paper is to describe in general terms position of the agricultural industry of this Colony, in order that mbers attending this Conference may find greater interest in their t, and may be in a better position to express their views upon tters which affect the prosperity and progress of agriculture in se parts of His Majesty's Dominions.

Agriculture has through the centuries been the main pursuit of native tribes. Upon it they depended entirely for their subsistence, their peaceful existence, excepting during periods of internecine fe, was not disturbed by traders interested in outside markets. ngs took a different turn about a quarter of a century ago when the vities of European farmers and commercial interests influenced course of events, and from that time it may be said that iculture commenced as an industry producing something more the mere personal wants of a sparse population of Africans living ndisturbed possession of the land without any commitments in ect of charges ordinarily levied upon landowners or tenants.

The experience of native agriculturists furnished no guide of great e to the alien farmer who had to depend upon the proceeds of duction suitable for an oversea market.

Picture a land of mountains, plateaux, forests, hills and valleys, watered with numerous rivers and streams, clothed with tation ranging from the mighty cedars of the forest to shrubs of open pastoral lands, and everywhere pasturage, nourishing and table to stock; a vegetation which in the main is not tropical in acter or appearance although the region is equatorial and in the ical zone; a land calling out for development and obviously essing potentialities of a kind unknown to the newcomer. Such the conditions which the pioneer settlers found. Not unnaturally a country in which the pasturage was abundant and appeared ritious everywhere did the early settlers regard stock farming as main pursuit in the early stages of development.

Apart from the extensive area known as the Northern Frontier trict which is arid or semi-arid in character and but very sparsely ulated, the main productive area of Kenya Colony and Protectorate prises about 30¼ million acres as native reserves, including about million acres held by the Masai tribe under special treaty, some

7.6 million acres, mostly in the " Highlands " (that is, country lying from 5,000 to 9,000 feet above sea level) which has been aside for alienation, and about 1.4 million acres included in the Coastal belt. In addition 1.9 million acres are held by the State as " Forest Reserves."

Both in the Native Reserves and the alienated area extensive areas of land of great fertility are to be found; land which, on account of its physical condition, is easily cultivated and made highly productive at comparatively little expense. A drought attended with serious consequences is seldom experienced—the adequacy of the rainfall coupled with abundance of sunshine for plant growth and crop harvesting creates a feeling of security in agricultural pursuits. It may be mentioned that it is wholly incorrect to say that the best land has been attached for European occupation. In the Kavirondo and Kikuyu Reserves and in other parts there are extensive areas of rich and highly productive land as fertile or more fertile than any held by Europeans.

COMMUNICATIONS.

Except for a short branch line from Nairobi to Thika the country has, until recently, been served by one railway line only, running from the Port of Mombasa to Kisumu on Lake Victoria and traversing practically the centre of the settled areas.

During the last year the new line to Uganda, which serves the Uasin Gishu Plateau, and branch lines to Trans-Nzoia, Solai, and Nyeri have been opened for traffic. The construction of several other branch lines is now under consideration. Substantial progress has therefore been made in recent years to facilitate the marketing of crops and disabilities which previously existed are fast being removed.

The roads of the Colony leave much to be desired and owing to the character of the soil and the rock formation heavy expenditure would be involved in constructing " all weather " roads for heavy traffic. The larger rivers and swamps have been bridged and banked, and although inconveniences may be suffered occasionally in the transport of produce and in locomotion generally it is not sufficient to hold up the business of the farm, and dry periods can be chosen for the movement of produce. The extensive use of motor cars and motor vehicles throughout the country is evidence that the roads, mostly " earth " in character, may be negotiated during the greater part of the year.

SETTLEMENT.

Of the $7\frac{3}{4}$ million acres available, about $4\frac{3}{4}$ millions have been alienated to Europeans, and of this acreage about $4\frac{1}{2}$ million acres are already occupied, of which about 425,000 acres are under cultivation. The number of European owners and occupiers is about 1,800. The average area cultivated by each occupier is about 250 acres, but including the area developed for stock raising the acreage beneficially occupied is 1,400 acres per occupier on an average.

Another figure of interest is the average amount realised per occupier for export products. It stands at £900. In addition there is the value of products sold locally.

The figures quoted above disclose a satisfactory position, one which will compare most favourably with the returns appertaining to

lement in other countries, and it is doubtful whether they can be roved upon by any. In no small measure is this achievement due the opportunity which the settler possesses of supplementing own effort by the use and employment of native labourers.

Briefly, save for a few freehold grants, land is held on leasehold n the Government, either under the Lands Ordinance, 1902, for a n of 99 years, or for 999 years under the 1915 Ordinance. nversion of the 99 to 999 year leases is allowed by permission of Governor. Under the 1902 Ordinance annual rents range from ents of a shilling to 24 cents of a shilling per acre, whilst under 1915 Ordinance rents are fixed at 20 cents of a shilling per acre.

The rent payable is revised every thirty years and certain elopment conditions are expected to be complied with at the mmencement of the lease.

From time to time such Government land as is available is sold public auction, but at present the best opportunity which exists securing a selected holding is by acquiring it from original ottees of freehold or leasehold land by private treaty.

Land values vary greatly—good land suitable for growing a iety of crops, including some for coffee, can be acquired at £2 £4 per acre; in recognised areas where maize production is ady highly successful, £4 to £5 per acre is obtained; while that tion suitable for coffee in a recognised coffee-growing area may valued at £10 and upwards per acre. In pastoral areas values y vary from a few shillings to a few pounds per acre, according the carrying capacity and other factors.

Farming conditions in Kenya are not suitable for the man with ill capital, dependent largely upon his own effort and that of family to secure a livelihood. Rather does the Colony offer ractive propositions for the man with a fair amount of capital, or roup of shareholders furnishing capital sufficient for the develop- nt of an estate of considerable dimensions.

The minimum amount of capital which may be required by a ler cannot be definitely stated, as the capacity for "making d" varies so much in individual cases and upon the system of ming to be pursued.

The wages of ordinary native labourers vary at present n Shs. 15/- to Shs. 20/- per mensem, while for semi-skilled kers the pay ranges from Shs. 25/- to Shs. 30/- per mensem, h inclusive of the cost of food supplied. Commonly native kers with their families live on a portion of the farm set aside their use and the grazing of their stock.

RICULTURAL CONDITIONS.

Crop cultivation embraces the vegetation of tropical and sub- pical to that of temperate zones. Consequently the crops are y diversified in character. A wonderful range of climate from hot Coastal lands to the equable climate of the Highlands and colder conditions of mountain slopes accounts largely for this at variety.

Parts of the alienated areas and the native reserves are most table for crop production, others are essentially pastoral, and re are others favourable for mixed farming where the necessary nditions merge one into the other.

The tendency at the present stage of development of agricultur in this Colony is for production to be specialised along one particula line on comparatively large holdings, e.g., in sisal, maize, wheat coffee, or sugar cane, but in the course of time a system of mixe farming is likely to be practised in some districts, with advantage to the community and greater security to the farmer.

To reduce the number of labourers required and the risk consequent upon a shortage of labour supply, labour savin machinery and appliances are being introduced, and used to a increasing extent, while agricultural tractors and heavy moto vehicles are displacing the draught ox. During recent years marked improvement has been effected in the organisation of labou on farms, with the result that the volume of production per uni of labour employed has increased immensely, and the cost o production has been reduced.

The Agricultural Census, as at June 30th, 1925, revealed th following interesting facts in respect of the main crops on Europea holdings: The acreage of maize increased from 75,000 in 1922 t 156,000 in 1925; corresponding figures for other crops are, fo wheat, 14,000 and 26,000; for coffee, 43,000 and 65,000; for sisal 37,000 and 53,000; for sugar cane, 3,700 and 6,500. Reductions hav taken place in flax, wattle, lucerne, and pulse crops. Te makes its appearance as a new crop with 400 acres planted; th acreage under barley, oats, fruit, and coconuts shows n appreciable change.

Substantial increases under maize, wheat, sisal, coffee, suga cane and tea are likely to be shown in the census now bein compiled.

Under the existing conditions of cultivation in native reserve and the illiteracy of the population it is quite impracticable t attempt the quotation of figures relating to areas under cultivatio and total production in the native reserves, but some informatio will be given later in this paper to indicate the progress made in tha direction.

Coffee is a substantial well-established industry. Some 65,00 acres have already been planted, and the area is increasing annually Although many of the plantations are not yet in bearing, coffee to th value of three quarters of a million pounds sterling is exported pe annum, and ere long the exports should reach the value of on million. Because of its mild character and valuable liquorin quality " Kenya Coffee " commands a high price and is in grea demand. On established plantations the yield—about 6 cwts. pe acre on an average—is high when compared with other coffee-growin countries. Coffee planting is a most attractive proposition in Kenya and is deservedly popular, as affording a pleasant and remunerative occupation well suited to those who wish to retire to a small estate while for more energetic people a larger plantation or estate offer opportunities for a sound investment and the means of a considerable annual return. In several districts coffee-planting is combined with maize growing. This practice is to be commended, as the maize cro provides quick returns which assist in meeting the expenditure o development pending the period when the coffee reaches the bearin stage.

Maize has been grown *by* natives in Kenya for a long period of
ie, and in the settled areas there has been a remarkable expansion
its cultivation. The areas under the crop on European holdings
s now reached about 200,000 acres. An export trade has been firmly
ablished and is expected to reach one million bags from this season's
p. In order that the high quality of Kenya maize may be protected
l that the trade may be conducted to the best advantage, Govern-
nt has instituted official and compulsory grading and a drying and
aning plant for the conditioning of maize, when necessary, and
or to export, has been provided by Government at Kilindini.

Remarkably high yields are obtained on individual holdings, and
average for the Colony already equals that of the United States
America, and Argentina. District yields have reached 38
shels on the average, and for the country the average yield is about
bushes per acre. Costs of production and marketing are low, due
advantageous conditions, viz., comparatively cheap land, rich in
tility; cheap unskilled labour; low costs of cultivation, and transport
h draught oxen; also favourable railway and steamship freights.

Sisal.—This valuable fibre occupies an area of about 55,000 acres,
l there is a steady expansion. Present production is at the rate of
ut 14,000 tons per annum, valued at over £500,000 at the port of
pment. The industry has now been placed on a sound and
nomical basis in respect of estate management, the costs of
duction having as a consequence been greatly reduced. Sisal-
wing is adapted to control and management under a farming
npany and at ruling market prices considerable profits are being
ie.

Wheat.—Under a heavy protective duty on wheat and flour,
production of home-grown wheat has been encouraged. The area
n is gradually increasing, and the Colony should soon be self-
porting in respect of its needs in wheat and flour, with a surplus
cient for the needs of neighbouring territories. On account of its
i milling quality, particularly in its high gluten content, Kenya
at is likely to find a ready demand, when there is a surplus
duction available for export. On individual farms average yields
eeding 30 bushels per acre are recorded, but the "country"
rage is lowered through failures of crops due to "rust" and the
ng of wheat in some areas not suited to the crop, but with the
wledge now acquired in respect of rust resistant varieties, and the
ag of varieties possessing that power to a marked degree, yields
uld steadily increase. In the higher colder parts of the Colony
re are extensive areas of land well suited to wheat growing, and
costs of production are low.

Flax growing on a commercial scale was commenced during a
iod of "boom" prices. Flax of good quality was produced in the
der parts of the Colony at the higher altitudes, and a system of
cial grading was operated successfully, but low prices and depressed
certain markets over an extended period caused growers to
ontinue growing the crop and it has now ceased to be an important
.

Sugar Cane planting is still in its infancy, but sufficient has been
e to prove the suitability of several areas of the Colony for this
p. High yields of cane are obtained under natural conditions of

rainfall and soil fertility. One large sugar mill has been established, another is shortly to be erected, and smaller ones are being installed. The industry is protected by a high customs duty, and the production of sugar has now reached the local demand. It is anticipated that an export trade will shortly be established.

Wattle Bark.—The black wattle, *Accacia decurrens*, flourishes and grows to perfection in certain districts, but unfortunately the absence of sea freight during the war when the first strippings of bark were ready to be shipped arrested the progress of the industry. A factory has now been established for the manufacture and export of tannin extract, and a quantity of dried bark is being shipped oversea.

Pulse Crops.—Peas and beans are produced in quantity, both by Europeans and natives. Samples of high quality are grown, and the output is favoured for seed purposes in other countries, notably France.

Other Crops.—Barley of a quality suitable for malting is grown in some districts. Good returns are obtained, and it is not unlikely that with the production of increasing quantities parcels will be exported.

Buckwheat thrives well, also sunflowers, and much interest has recently been taken in the growing of castor seed, the plant of which grows luxuriantly. Several other crops are being grown on an experimental scale, and on present information it is seen that the productivity in respect of different varieties of marketable crops is practically unlimited. Crops rich in starch content can be grown in abundance, and favourable conditions may be found for the manufacture of industrial alcohol therefrom.

Tea planters who have had experience in other countries hold the view that in several districts in Kenya all the pre-requisite conditions for successful tea-growing obtain, e.g., high altitude, rainfall of 60 to 70 inches well distributed, and forest soil. Land is being acquired for tea planting, and quantities of tea seed are being imported. Reports upon tea already produced from a small number of bushes, grown experimentally, are very favourable in respect of quality, but as might be expected, in the absence of proper facilities, the preparation was deficient.

Fruit Growing is pursued on a scale sufficient only for local needs. Most kinds of tropical and sub-tropical fruits can be grown with some success. Citrus trees of various kinds grow luxuriantly without irrigation, but no serious attempt has yet been made to export the fruit. An experimental shipment of plums was made to the London market and it gave a nett return of Shs. 1/9 per case of 4½lbs. at the station of despatch.

With such a variety of crop production there exists a great need for experiment. To the credit of the colonists much valuable work has been done by them in introducing and testing different varieties of crops and economic plants, and as far as its resources allowed the Agricultural Department contributed to that effort. The farming conditions of each district are, however, so variable that it would require a large number of experiment stations to serve the needs of the Colony, and the Colony is not at present in a position to equip and staff them adequately. A system of co-operative experiments

ith farmers has, therefore, been adopted, and though the lue of such experimental work is limited, useful information is tained. The weaknesses of that method of carrying out perimental work might be rectified to some extent if a mobile staff nsisting of a trained experimentalist and a few semi-skilled labourers re available to put down, harvest and record the experimental plots the right season.

OAST AGRICULTURE.

The agricultural conditions along the Coastal belt differ widely om those of the Highlands, and there is evidence that in some spects they have not improved since those days in which "slaves" erformed the tasks on the land for their Arab and Indian masters. uropean interests have developed coconut plantations during recent ears with success, and the palms are about to come into bearing. n increase in the export of copra is therefore promised.

Several sisal plantations are producing fibre in considerable uantity, and there is scope for further development. Rice of good uality is produced, but dependent as it is upon the flooding of rivers, is a precarious crop. Areas suitable for cotton growing are known exist, and some progress is being made. Simsim is also grown ith success, but groundnuts are not promising.

ATIVE AGRICULTURE.

Inasmuch as the native tribes occupy approximately four times e area available for alienation, and that much of the most fertile d highly productive land in the Colony, it will readily be seen that the Colony is to be fully and properly developed the native reserves ust contribute in an increasing degree to the trade and commerce the country. This question is of paramount importance in relation capital expenditure upon new railway and harbour works and milar heavy commitments. The justification and wisdom of urring heavy expenditure upon public services generally must ntually rest upon the productive capacity of the native population ether working on their own account or engaged in rendering service those who have invested capital in the development of industry. It uld be prudent to recognise that with all the stimulus that can be l the African is slow to change his habits and marked progress must vitably be slow. It is not proposed in this paper to enter into the icacies and complications of the relationship between the develop- nt of native and non-native agriculture, suffice it to say that the blem will only be solved when every male native who is of working and also is physically fit will work regularly throughout the year, er on his own account or that of his employer. An undue share the work involved in native production is, under existing native ats, dependent upon the efforts of the women folk, who might be antageously engaged on greater service in the work of the home the care of their children thus reducing the heavy mortality which present exists among child life. Nothwithstanding the lethargy ich continues to obtain progress has been made.

Measured by the value of agricultural exports of native production re is a substantial increase. In 1922 that value was £176,000 and 1925 it rose to £565,00. At the same time the quantity and value native produce sold and consumed locally must also have stantially increased. Concurrently with this increase in production ives have been employed on farms, railway construction, and blic services generally, also in other work in increasing numbers and

the amount of money now circulating among the native population has increased enormously during recent years.

Apart from the production of food crops for their own use the chief sources of revenue to the native grower in the sale of produce lie in livestock, hides and skins, ghee, maize, pulse, simsim, groundnuts, cotton and copra.

Inasmuch as a section of this Conference is interested particularly in cotton production it may be mentioned that the areas suitable for cotton production in this Colony are restricted to the low country on the border of Uganda, the Lake shore, parts of the Coast and small areas elsewhere. The volume of production of cotton will not reach large dimensions, and even in areas favourable to the crop the grower has the choice of other crops which may prove more profitable, depending upon the price realised for seed cotton.

Livestock Industry.

The numbers of stock, as shown in the Agricultural Census of 1925, are:

European-owned:	
Cattle	216,589
Sheep	178,796
Pigs	8,564
Native-owned (estimated):	
Cattle	3,200,000
Sheep and goats	6,000,000

Of the European-owned cattle, 80,626 are working oxen. The annual increase in breeding stock is small. Between 1922 and 1925 the number of European-owned cattle (other than trained oxen) increased from 119,988 to 135,963. About 68 per cent. of the breeding stock are of improved type. The chief breeds which have been used in cattle improvement are Shorthorn, Friesland, and Ayrshire. In recent years some other European breeds have been introduced. In 1925, 164 head of pedigree cattle of different breeds were imported chiefly from Britain and South Africa.

An East African Stud Book was established in 1921 for the registration of pure-bred stock. The pedigree records are carefully scrutinised and endorsed by the Department of Agriculture before being published.

The native-owned cattle are of the Zebu type and for the most part they are fine of bone and heavily fleshed, but they are small—the carcase varying from about 250 to 400 lbs.

Stock diseases are prevalent, and it can safely be said that only through the activities and value of the services of the Veterinary Department is stock farming an economic proposition. The chief diseases causing heavy mortality are: Rinderpest, East Coast Fever, and Pleuro-pneumonia. Extensive use is made of immunisation services in respect of Rinderpest, and against pleuro-pneumonia cattle are being vaccinated in increasing numbers. In 1925, 185,888 head of cattle were double inoculated or otherwise treated against rinderpest, with an average mortality of 2.2 per cent. During the last year there has been a remarkable change of attitude of native stock owners to inoculation services. They are now offering their stock in large numbers for treatment against rinderpest and pleuro-pneumonia. No less than 295,320 doses of pleuro-pneumonia vaccine were issued by the Veterinary Research Laboratory in 1925.

The case of East Coast Fever differs from that in South Africa Rhodesia, inasmuch as it is endemic in this territory. Immunity ast Coast Fever is only secured in the native reserves with a heavy ality varying from 20 to 60 per cent. among the calves. In the ed areas protection is afforded through dipping, but outbreaks in s regarded as " clean " occasionally occur. There is little or no ing on farms.

Trypanosomiasis occurs at the lower altitudes. There is no ence to show that " tsetse fly " belts, as hitherto known, are nding, sporadic outbreaks of trypanosomiasis have occurred at udes even as high as 7,000 feet, but they are not accompanied by y mortality, and it is believed that in most cases the " fly " is duced by big game in the course of their migrations.

Foot and Mouth disease is of the mild type and is not accompanied erious mortality.

Horse sickness occurs, but it would appear that the disease is less lent than in South Africa. In any case the number of recoveries Kenya appears to be greater. Among sheep parasitic diseases, -tongue, and a lung disease in one area account for most of the hs, but with efficient management they are not unduly high. ng pigs occasional losses take place through outbreaks of swine r, but they are uncommon.

During the last two years there has been a marked change in cattle trade. In 1922 and 1923 native cattle for slaughter purposes ised about Shs. 10/- per 100 lbs. dressed weight. Since then es have steadily advanced and to-day Grade oxen are selling at per lb. and oxen of native type at $2\frac{3}{4}$d. per lb. dead weight.

The demand for oxen for draught purposes is not fully met by supply with the result that they fetch higher prices for that se than for slaughter.

Through the increased prosperity of the natives, and through the sion of meat in the ration of large numbers of native labourers oyed on the railway and agricultural properties, there has arisen stantial trade in meat for native consumption. Natives are ubtedly now eating more meat. The diet of natives in their own es, as well as when they are engaged as employees, would gain in utritive value from an addition of meat. It is remarkable that ral tribes, owning large numbers of stock, eat little or no beef, at a time when they are suffering from mal-nutrition.

There are opportunities for developing a considerable export in from Kenya to Uganda, to supply in particular native needs in territory. Meat of the quality available, and in quantity, is ly suitable for the native trade, and it is a trade which should be ited and developed. In it will be found the best market for supplies. But it is essential that meat for native consumption ld be supplied at a low price within the means of the native to and in order to encourage its use.

Large numbers of cattle will continue to be maintained on farms in native reserves, but it should be observed that Kenya is not a nching " country in the proper sense of that term. For that se land must be obtainable at a very low price. A great part of lienated area as well as much of the land in the native reserves

possesses a productive value far beyond that associated wi
" ranching " and in the pastoral districts of " settled " areas the lar
is of higher value for dairying and sheep raising than it could reali
for the ranching of " beef " cattle.

The immediate and best opportunities for the development of th
cattle industry lie in dairying in respect of European herds; and amo
native stock in the supply of beef cattle for local consumption, ox
for draught purposes, and the manufacture of ghee from surplus mil
With the provision of a Cold Storage Plant at Mombasa a certa
amount of " ship's trade " should be done. Hides, althou
representing a considerable sum in the value of exports, should on
be regarded as a bye-product.

The view is expressed that the best market for native bred catt
exists within East Africa and that should be exploited.

The prospects of establishing an export trade in frozen or chill
beef is not, in my opinion, within measurable distance. There a
no indications that in the absence of a serious change in the world
meat supplies Kenya can develop an export trade in meat for ma
years to come, and the value of cattle for the manufacture of by
products is very low indeed, much lower than native stock owners
Kenya have been accustomed to receive for some years past.

In time, the attitude of mind of natives towards their cattle ma
in some respects, change, and they should be encouraged to view the
as a marketable asset, less associated than they are at the prese
time with sentiment and their social life. It is the common practi
for cattle to be retained until they depreciate in value or succumb
poverty or disease, and there are instances in which pastoral areas
native reserves are overstocked. Government has decided to adopt
policy of control of native stock and in an Ordinance which recent
passed through Legislative Council power was given to define or lim
the number of stock which may be carried on a prescribed are
Legislative powers of this kind, though exceptional, are calculated
be used only in the interests of the natives themselves, and provid
a market exists for the stock, there can be no hardship. In conjun
tion with measures of control as indicated above, disease preventi
and eradication coupled with stock improvement along systemat
lines should be carried out.

Sheep.—Most of the sheep in the alienated areas are graded u
from Native bred ewes with Merino rams. It is remarkable ho
quickly the hair and " kemp " of the native sheep is bred out. Ev
in the third generation a marketable wool is produced. The export
wool, though comparatively small, is steadily increasing. Extensi
areas of pastoral land suitable for sheep breeding are now being open
up and in the course of a few years a definite advance should be se
in wool production. Native sheep owners find a good market f
mutton sheep, and the sale of ewes to European farmers as foundatio
stock for their flocks.

Pigs.—Progress in the Swine industry has been somewh
disappointing, but for the last few years the Colony has been practicall
self-supporting in respect of bacon and hams, chiefly through th
activities of one Bacon Factory. Pig-keeping is really regarded as
" side line " and large farmers are not attracted to this branch, b

development along the lines of "mixed farming," and
icularly on dairy farms, it may be expected that pigs will be
and fattened in larger numbers than at present.

ICULTURAL EXPORTS.

From a value of £208,611 in 1914 agricultural exports rose in
to £924,140 and in 1925 to £2,296,698. The value of agricultural
uce of local growth and manufacture consumed either in Kenya
neighbouring Territories cannot be arrived at with that degreee
ccuracy necessary for statistical purposes, but it is considerable.
approximate value of certain animal products sold in the year
ng June, 1925, was: Dairy Products, £88,886; Bacon and Hams,
700; Wool, £31,320.

ANISATION.

In conclusion a brief outline of the main features of the
nisation of the agricultural industry and the Department of
culture may be given.

The Convention of Associations, with its affiliated District
ciations, considers, among others, agricultural matters, and makes
sentations to Government. In addition, bodies like the Coffee
ters' Union, and the Sisal Growers' Association, watch the
sts of the industry they represent. Companies such as the
ya Farmers' Association and Plateau Maize Growers Ltd., both
ng chiefly in maize, also the Lumbwa and Kenya Creameries, are
n co-operative lines. The wheat industry is represented by two
-date grain mills; coffee by several cleaning mills; and sugar, as
dy stated, by one large and several smaller mills. There is also
well equipped bacon factory.

The Agricultural and Horticultural Society of Kenya organises
periodically at three show centres, Nairobi, Nakuru, and
et. The Government contributes towards the expenditure of
society by a Grant-in-Aid of £500 per annum. There is also a
cultural Society holding Horticultural Shows at Nairobi, and a
y Club.

In the Native Reserves the Native Councils recently created are
ing to take an interest in agricultural progress and to vote sums
ney for agricultural services. Native Agricultural Shows are of
origin and during last year eight of these were held throughout
ntry. The educational value of these shows is increasing
, and these gatherings offer an opportunity for the Administrative
gricultural Officers to encourage more and better production.
also serve as an index of progress in the reserves generally.
a vote of the Department of Agriculture a grant of about £25
de to each Show for prizes.

The organisation of the Department of Agriculture embraces the
Divisions of the Veterinary Department—the Administrative and
tive Division, and the Division of Veterinary Research, also
is dealing with Agricultural Chemistry, Entomology, Mycology,
-breeding; Agricultural Statistics, Crop Estimates, and
rological records; Grading, Grain Conditioning, Plant Import
tion, and Cool Stores at the Port; and Native Agriculture,
ding two Native Agricultural Schools. Research work is
taken at the Veterinary Research Laboratory at Kabete; and

at the Henry Scott Agricultural Laboratories, in the grounds of which some experimental work is also undertaken. Co-operative experiments with farmers are also carried out on wheat, maize, and coffee in different districts.

The difficulty of providing the many services which should be rendered by a Department of Agriculture, efficiently staffed to carry out its functions, is being acutely felt at this stage of development of the Colony. Only those closely associated with the day to day administration and activities of the Department of Agriculture, serving a country so young in its stage of development and about which so little is known, can fully realise the paucity of information and knowledge possessed of its resources, and the best methods to be adopted.

The need and the importance of well-organised Departments of Agriculture in the Crown Colonies was forcibly expressed in the report of a Committee appointed to advise the Secretary of State, which said " In the course of our enquiries we have been profoundly impressed by the magnitude and importance of the tasks which the Colonial Agricultural Departments have to perform." Again, " But, though our proposals deal only with existing conditions, we should fail in our duty, if, in framing them, we did not bear in mind the enormous development which is certain to occur both in the responsibilities of the Colonial Agricultural Departments and in the scope of the benefits, which they will, if properly equipped, be able to confer on their particular Dependencies, and on the Empire at large."

It is remarkable that while in older countries, e.g., in Britain, the Continent of Europe, the United States of America, and elsewhere, countries with great agricultural traditions extending over a long period of time, there is an increasing recognition of the value and need of agricultural research and experiment and services of that kind are continually being increased, yet in young countries, where comparatively little is known of agricultural practice and the application of agricultural science to it, the support both of Governments and Colonists is not infrequently difficult to secure for services of that kind. The demand is for immediate and tangible results and that cannot always be assured, with the result that technical services, essential and valuable to the industry, are not provided.

It may be said that as compared with other countries the services to be rendered here are applicable to a comparatively small number of people engaged in agricultural pursuits, but it should be noted that agriculture in Kenya is not confined to one or two major products. It is very diverse in character; the problems to be dealt with are numerous. Native as well as European interests require attention, and ever there is the proper desire on the part of a highly intelligent farming community to be in the vanguard of progress and method. The position is that the activities of the Department of Agriculture in Kenya are not governed by the extent of the service, but by the large number of services which have to be rendered and subjects which have to be dealt with.

The expenditure of the Department of Agriculture in 1925 was £101,210 and the revenue received £33,599, chiefly derived from inoculation and grading fees, and sales of sera and vaccines.

This review, lengthy as it may be, does no more than attempt to indicate broadly what is the agricultural position in this young colony. Let me conclude by saying that it is hoped that you will find interest in Kenya's progress and problems. It is believed that your presence here and the experience you bring to this, the first Agricultural Conference held in East Africa, will assist the country generally in promoting its agricultural industry, and speaking for the staff of the Agricultural Department, we extend to you a cordial welcome.

HIS EXCELLENCY said that he took a daily interest in agricultural subjects and was glad to hear Mr. Holm's clear review of agriculture in Kenya. Directors of Agriculture constantly required more funds for their department and it was not often possible to satisfy all their needs. A large proportion of the available funds had been set aside in Kenya for research and experimental work and he was hoping to see Kabete opened shortly as a centre of veterinary research for East Africa. Any suggestions which the Conference could make to assist experimental and research work would be gladly welcomed.

CHAPTER II.

ECONOMIC PROGRESS OF THE TANGANYIKA TERRITORY.

Mr. KIRBY made the following statement:—

As the paper* on this subject that has been put before you during the Conference is rather statistical than attractive I propose with the permission of the Chairman to deal with the subject in a more congenial manner. The idea in writing the paper was, to begin with, to give members of the Conference some notion of what Tanganyika produces, and how she has grown in economic importance since the occupation by the Germans.

Our first most important agricultural activity is the entirely native production of sisal, in regard to which our aim is first to equal the German production. As you see from the table accompanying the paper our present production of sisal is three and a half thousand hundredweight, as against the German production of four thousand hundredweight; but it will be found that, owing to the increases in prices since the war, our value is greater than that of the Germans; our production ,as you are no doubt aware, has been kept back by the war conditions during the time of which the sisal estates were largely allowed to lapse into ruinate condition. After that time, estates fell into the hands of the earlier lessees who took all they could out of them, putting nothing back. Our greatest difficulty about sisal expansion in Tanganyika is the water problem. There are very large areas where it is possible to grow the crop with the greatest success—they are most suitable areas; but as many of us know, for modern methods of decortication, we require more than a moderate supply of water; and it is that which is the difficulty. Some of us have heard recently of a peripatetic decorticator that saunters through the plantation, carrying the leaves with it and tearing the fibre out of them as it goes; but it does not seem as yet to be a practical possibility.

* T.C.(C)Ag.10. For text of paper see Appendix.

Our next export of importance is cotton—a produce in which we are nearly all much interested. That product has, as you see from the table, reached the second place in importance. In the time of the Germans its order was the fourth place. I am glad to say that, in the course of about four years, we have been able to surpass the German output. In 1913 the German export of cotton was nearly 44,000 cwt.; last year our output was over 90,000 cwt.—more than twice as much. That means that we have done in just over four years more than it took the Germans fifteen years to do. This opens up a question of policy, but I think it is a point in favour—at any rate under our conditions—of a native cotton growing industry. The proportions of the production are at present partly estimated, but I think may be pretty accurately stated at native 63% and non-native 37%. An important matter for the consideration of the Agricultural Department has been prevention of depreciation of the cotton, and as we do not now possess the assistance of technical officials of the Empire Cotton Growing Corporation, or of any other origin, we have had to use rather rough and ready means. In the use of these methods legislation is very important: by legislation we are able to get all the kinds of seed we like that the ginneries may produce, and we distribute that seed freely to the natives. Our aim has been, when obtaining seed, that it should be of first quality, and we have attached great importance (on the advice of our entomologist) to the earliness of cotton; that means that we aim to get seed from the first pickings; but as there is very little difference in the long run we sometimes take some of the second quality as well. In that way we have attempted to prevent the cotton of Tanganyika from deteriorating; and all the reports on it that we have received show that it has not deteriorated.

For increasing the quantities of seed of good quality we use seed-farms. We have had, through the kindness of the British Cotton Growing Association in Uganda, a free gift of seed, which we increased from 95 tons to over 500 tons suitable and used for distribution purposes, employing one of the islands of the Territory as a seed-farm; and the production of that 500 tons of seed was accomplished without one penny of expense to Government. In addition to that, we have a superior cotton, as is proved by different reports, which was produced by Mr. Wood, sometime Cotton Specialist of the Corporation at our station at Mpanganya. This cotton is commonly known as " M " Cotton. It is having excellent reports, and we have raised, in the first year of work for its increase the quantity to about 14 tons; and this year we hope to obtain over 150 tons of good seed, or sufficient to supply one whole district in the Territory. That has also been obtained with the co-operation of certain non-native planters, without any expense to Government.

From cotton I turn to coffee, the third product in the list, which we found of so much interest this morning. The production of this commodity has increased very greatly since German times and the quality has at the same time improved. In Tanganyika most of our coffee, oddly enough, is produced by natives. We have two distinct coffee industries, one in Bukoba on the western shores of Lake Victoria, where over 3,000 tons of coffee are produced almost entirely by natives; then we have in the Northern

ince, on the slopes of Kilimanjaro and Meru both non-native and ve production.

The proportion of coffee that is produced by natives of the whole uction in Tanganyika—by value—is 67%, which, of course, means by weight it is very much larger, on account of the fact that the oba coffee is inferior to the Kilimanjaro coffee.

We have a special problem in the Northern Province—that is, on slopes of the two mountains already mentioned—a problem of a ar nature to that which is being tackled in Uganda—that is, the uction of native coffee under adequate control. Our problem, ever, is somewhat complicated by the close adjacency of the non-ve estates. In the native industry of coffee in this particular n Government does not encourage its production. We encourage production of native foodstuffs, which is a very important matter, uch more important matter to the native than coffee production; we put no obstacle in the way of the native who wishes to grow e. We exert, as far as possible, a sympathetic advisory attitude. rder to maintain effective control we are introducing legislation h applies to the native and non-native alike.

One most interesting feature of this native coffee industry is the ation of a Native Planter's Association; this Association has no ection with Agricultural or Administrative Departments but is an ciation that, after being established with the sympathetic aid of e Departments, is able now to stand on its own feet. It is a perative association, which, by means of a small subscription cted from its native members, is enabled to buy the appliances materials that are required for protection not only of the native e of the industry but the non-native phase.

In this way the natives are able to obtain, collectively, nces which they would not have acquired individually. Now ver they not only possess those resources, but also ship their own

When there have been difficulties about coffee shipment we tried auction markets, but a buyer's ring was formed, and these ts had to be abandoned: now the native coffee is sent to on by the Association itself. It is first of all graded under the tion of the Agricultural Department; and it is an interesting hat that coffee obtains prices equal to those offered for non-e coffee, and, in some cases, in excess of them.

Furthermore, I have had examination and report on the coffee by the Imperial Institute, and the reports are to the same effect e reports of the brokers who actually handled the coffee as a mercial product.

Our fourth product is hardly agricultural but it is mentioned with others, namely, hides and skins.

This export has increased greatly in recent years and its value has enhanced through the work of the Veterinary Department in ing the proper treatment of the hides. Increased production for t quickly followed the removal of an export tax; and output also nds on the incidence of cattle disease.

Our next production, which is agricultural, and one of the most rtant in the Territory, being the fifth on the list at the present is groundnuts. That product, again, has increased very greatly,

since the time of the Germans: it has increased largely through th efforts of the northern tribes—the harder-working tribes. The outpu in the Territory is probably 20% more than the export, or a little le than that—that is an outside figure, because curiously enough, excep in times of dearth, groundnuts are not consumed to any great exte by natives; the consumption is by Indians and the more sophisticate Swahili.

Last year we had a lower production, which brought the ground nut down on the list from its position in the former years of secon to the fifth place. That, of course, is only a temporary matter, owin to unfavourable weather. We possess the problem that you have i South Africa, and that they have also on the West Coast, known a Rosette disease or " bunching " disease of groundnuts, and that las year helped to decrease the output very greatly. It may be interestin to mycologists and others, as a general observation, that this year reports show that there has been very little of this disease in th country; so that whatever may be its cause—whether it is due to som virus carried by an insect, an Aphis, or not—there is no doubt tha climatic conditions have a lot to do with the incidence of this disease We consider this crop of very great importance in the Territory—s much so that, as you have probably read in the report which is know as the Schuster Report—we are thinking of making a special railwa —which the profane allude to as a " Monkey Nut Railway "—betwee Itigi and Mkalama north of the Central line.

Our next production, copra, is one which is maintained, in spit of the neglect of the plantations; and I think Miss Welsford will agre with me, that the less said about it the better, for both in the plantin and preparation of copra the management of this product is about th worst on earth. We have great difficulty in trying to improve eithe of these matters, because, except in some exceptional cases, the palm are owned by small holders, and when, under our law, we try t prosecute we probably find that the trees that are the subject o complaint are owned by some old dame, without any resource whatsoever. In addition, in different parts on the Coast, th ownership is so involved and complicated that we are unable to get a these people. It seems to me, although I am open to correction, tha improvement in the husbandry of coconuts and the production of copra is a matter of economics rather than agriculture or mycology; bu before we can do anything it seems that planters or plantatio syndicates must buy out all those people, and, possibly take those o the more brainy of the owners as overseers or managers to th syndicate. Whatever we do otherwise than this I do not think tha we shall improve our coconut growing or our copra.

Number seven on the list is simsim, a product that Uganda i interested in as well. This product, like rice, always maintains a ver steady export. Why, it is hard to say; but there are various cause which make the proportion between the output and consumption suc that the exports vary little from year to year, notably the amount o buying and stocking on the part of Indian shopkeepers.

Rice and simsim are similar in that matter. Simsim is exported I may mention, principally by Indians; it is mostly a woman' perquisite: the oil is used largely in cooking and also for anointin the body. We are trying to improve simsim, but with our smal staff we have to do it on a large and broad scale, an our method at present is to be its introduction from district

ere simsim is of better quality, into other districts where it is not so good quality, distribution not being haphazard but being ntrolled, so that we know the centres from which distribution is ng made and to what other centres we are reaching out. I may ntion that the output of simsim in the Territory for last year was out equal in value to that of ivory, a product of more attractive erest, but thus only equal in importance to the seventh agricultural oduct.

As regards rice, we have some very excellent kinds of indigenous e; and so far we have not had the advantage of plant breeders to able us to do any improving; but we are trying to increase our tput, and we shall bring about greater production of those kinds a carefully controlled distribution, with the aid of native ministrations, which will gradually extend and enlarge the areas of e better kinds of rice, and oust, we hope, the less valuable kinds.

Plantation rubber is quite a new thing to us. In German times was one of the principal products—next to sisal it was the most portant product of the country; it was largely developed at that time means of British capital. As a legacy of the Germans we have ry large areas of that "beautiful" plant, Ceara rubber. Last ar, owing to the state of the market—as we all know, every kind rubber got higher prices for a short time—Ceara rubber became of ater value, and on some of the estates that were the least apidated, so to speak, tapping was done and produced quite a asonable quantity of rubber, most of which went to Hamburg. This w production we do not expect to be able to maintain: it was a oduction that ousted millet—or I might say more accurately, the llets—from our first ten important exports. Our millets are an portant production; the amount of export depends on three things: weather, which gives the bulk production; the amount of demand re is for them in Northern Africa and India, where the millets gely go; and, also, to the way in which economic conditions happen oe affecting the Indian trader.

Returning to plantation rubber, which, as I said, ousted the llets from their former importance, it is quite possible that there ll continue to be some demand for that product, now that it has been covered that the very existence of its resinous content, which ught it into disfavour as compared with other rubbers in former rs, has proved itself a property of advantage; and it is being used, stly in Germany, for electrical insulation, especially under water.

Beeswax is an export that has decreased very largely since the e of the Germans, owing to the wasteful way in which they couraged its collection, at the expense of the producers of it, the es. We hope, however, in time to remedy that; it will take time, but r Entomologist, Mr. Ritchie, has devised means of teaching the tives both the proper way in which to deal with the wax and the st kind of hive in which to collect it. Although low in the scale the lue of the export of beeswax is equal to that of gold: that more cturesque product of the Territory.

Another new export is cotton seed. Cotton seed last year through rket conditions became our eleventh export in value, equalling mica, cond to gold, the chief mineral product.

Regarding the relative proportions of non-native and native production for export in the Territory, given by value in the second table of the paper, it may surprise some that these prove to be about equal. But for sisal, however, as the table shows, non-native export would be less than one half that of native; and there is the further circumstance that the conditions of the year taken as an illustration were such as to reduce considerably native production.

I may say in conclusion that Tanganyika is a territory largely surrounded by other territories, whose good example and enterprise it admires, and whose advice it craves. It is a coveted territory, a considerable proportion of which one of its neighbours has already threatened to bite off: and I might also refer to a smaller neighbour to the south-west, which, I am informed, wishes to imitate the small snake which tried to digest the large stone dog! Although I do not wish to assist in this painful piecemeal way of dissolution, I shall be glad to reply to any questions on the Territory which any members of the Conference might wish to put.

The CHAIRMAN (Mr. Holm) asked whether Government levied any charges for the services rendered in respect of the native coffee industry, particularly in connection with marketing.

Mr. KIRBY said that no charge was levied.

In reply to Mr. Bailey, Mr. Kirby stated that the production of kapok was largely in the hands of non-natives, and that the export amounted to some 60 tons per annum. They looked upon the kapok industry, however, as a menace to the cotton industry on account of the fact that kapok harbours cotton stainers, some of the most dangerous pests of that crop.

Mr. SIMPSON proposed a hearty vote of thanks to Mr. Kirby for his illuminating picture of the agricultural development in Tanganyika Territory. It had been a great pleasure to listen to him, because he had drawn his picture so graphically that they would all carry away a very clear impression of what present conditions were in Tanganyika.

CHAPTER III.

AGRICULTURAL SHOW.

The CHAIRMAN (Mr. Holm) read extracts from a letter from the Agricultural and Horticultural Society of Kenya, and stated that he wished to place the matter before the delegates at the Conference, in order to ventilate the subject and to see whether Agricultural Departments were able to recommend their Governments to support the proposals to hold an Agricultural Show representative of East Africa at Nairobi about July, 1927.

In reply to Mr. Fuller, Mr. Holm stated that he understood that if the Show took place the Trade Commissioner for South Africa might be able to arrange for some exhibition representative of the South African Agricultural industry.

Mr. SIMPSON said that there was no doubt that most of the work in connection with such a Show would fall on the various Departments of Agriculture. He had only one officer who could be deputed for such work, and he did not feel inclined to put this burden upon him, as his energies could be better devoted to work in Uganda.

anda had already satisfactory purchasers for all its produce, and ey did not require advertisement in this direction. This was only ersonal opinion of his own, and if the Uganda Government should ide to participate he would, of course, do his utmost to send from anda a representative exhibit.

The CHAIRMAN (Mr. Holm) explained that there would bably be two important Conferences in Nairobi during the course 1927—the Governors' Conference and the Unofficial Conference, and thought that it would be of great interest to the members of these nferences to see a representative Show of the kind proposed. It uld, of course, be of equal interest to commercial men. He agreed at, of necessity, the organisation and work of special exhibits would l largely on the various Agricultural Departments.

Mr. KIRBY stated that, as in the case of Uganda, Tanganyika d satisfactory buyers for all its produce; but that, in the event of Show being held, the Agricultural Department of Tanganyika would, der permission, be glad to contribute a general exhibit.

Mr. WORTLEY thought that the Chamber of Agriculture and mmerce in Nyasaland would not find itself able to support the posal with any degree of enthusiasm.

Mr. HOLM, in reply to Mr. Kirby, stated that when the proposal d been supported in principle it would be possible to make arrange- nts with the steamship and railway services for the provision of equate facilities.

In concluding the discussion, Mr. KIRBY, on behalf of the legates, thanked Mr. Holm for his explanation of the proposal and r the opportunity given for ventilating the subject.

It was agreed

That as the question of a joint East African Agricultural Show is now before the Governments concerned it is inadvisable to submit any definite conclusion. Should the Governments concerned favour the proposal, the Directors of Agriculture undertook to give all facilities within their power.

CHAPTER IV.

METRIC SYSTEM.

MONS. VAN DEN ABEELE wished to point out that he alised that this subject was rather a difficult one to discuss, and at it might take some considerable time for their wishes in this spect to be carried out, but perhaps in the near future the use of th English and Metric measures in English Agricultural Journals ght possibly be introduced. He thought it useful to point out how uch commercial relations would be facilitated by the use of common easures. He hoped that the use of such measures as a " bag " of ize might be discontinued. (The above was circulated in the form a note under T.C.(C)Ag.22.)

The CHAIRMAN (Mr. Holm) said that it was, of course, a complex question, which had already been fully discussed internationally, and this Conference might not feel that it was able to discuss the pros and cons.

Mr. FULLER suggested that they should not enter into any discussion on this subject but record a note to the effect that Monsieur Van den Abeele's suggestions have been sympathetically received by the Conference.

CHAPTER V.

GAME: PRESERVATION OR DESTRUCTION.

(Capt. Caldwell, Acting Game Warden, Kenya, attended for the discussion on this item.)

Mr. KIRBY advocated the destruction of game on the grounds, firstly, that by destroying crops it caused starvation among many native tribes; and, secondly, that it had the effect of making the natives congregate in fixed areas, with the result that cultivable land became exhausted, so that, for both causes, fatalities were many, especially among children, in seasons of dearth. The game was also instrumental in spreading tsetse fly and sleeping sickness, and caused a great increase in cattle disease; furthermore, the protection of game robbed the natives of a useful supply of food. He would like to see the natives allowed to help to reduce the numbers of game to reasonable proportions.

(The above was circulated in the form of a note under T.C.(C) Ag.15.)

Mr. FULLER thought it would be very helpful if the Conference could adopt a conclusion on the matter. There were many parts of Africa where European settlers were incurring serious losses owing to trypanosomiasis.

(Instances were quoted by two or three delegates of the damage done by game in Tanganyika Territory.)

CAPTAIN CALDWELL (Acting Game Warden) knew that he would find himself in a minority when he spoke on behalf of the preservation of game before his present audience. He would explain however that he never had been in favour of indiscriminate and uncontrolled preservation of game and cases undoubtedly arose where in the interests of man game must be destroyed. It had been stated that game caused, in some cases, starvation among the natives; he had never heard in Uganda or in Kenya that such was the case. The policy in these two territories was to preserve game in places where it could do no harm to anyone and to allow it to be freely destroyed where it was harmful, e.g., when damaging crops. Certain valuable trophies of game so killed were considered the property of Government, otherwise the killing would be done for profit and not for protection. In Kenya and Uganda cultivators were given power to kill game where it was becoming a menace, but these powers must be strictly controlled so that it would not be possible for the

vator to go far afield and kill game where it was doing no harm. natives who suffered most from game were those who, in order to e their tribal obligations or for other reasons, slipped away into ush and lived in small isolated settlements. He always under- l that it was the policy of District Officers to discourage such ions. Where native population was dense, e.g., the Eastern ince of Uganda and the Kavirondo and Kikuyu reserves in Kenya e automatically disappeared; yet he had never heard that in these s the soil had become exhausted. As far as he knew the only e in Kenya where there was any possibility of serious damage being by game was on the Athi Plains and with regard to that area a me had been proposed for fencing off the game and he hoped that uld soon be possible to carry this into effect.

The question of trypanosomiasis and game was still such a vexed that he submitted the Conference were not justified in coming to definite decision. He was prepared to agree that indiscriminate uncontrolled preservation of game could not go hand in hand with ulture.

Mr. SIMPSON stated that, so far as he was aware, game was not nace to agricultural progress in Uganda.

(Captain Caldwell left the meeting.)

SIGNOR GRILLO said that in the Province of Mozambique, e shooting was allowed during certain months of the year, and, nes, during the whole period of the year, in some districts with licences. To keep the game off the principal cultivated areas had borne in mind, with a view to preventing as much as possible transmission of trypanosomiasis. It was indisputable that the e caused considerable damage, particularly in native cultivations, he danger of contamination of the disease to cattle assumed a in considerable importance in agriculture and stock-breeding.

He, therefore, offered some observations on the subject.

A great portion of East Africa was covered with forests, where the e fly lived. Where it existed the cattle could not thrive, at least in economical lines which should guide agricultural exploration ive stock breeding. On those lines cultivation by Europeans was r rendered impossible or had a precarious character, and transitory se of annual cultivations. The indigenous cultivation was also poor and deficient. The systematic devastation of game, les being an excessively expensive undertaking, did not result in ng the region, except in very rare cases. The only sure ss of destroying or making the fly to disappear was deforestation. in few particular cases this might be deemed advisable. Thus, a process of immunisation against the disease was discovered, ts various forms, the land with tsetse fly would remain useless. thought that an experiment might be advisable to domesticate in kinds of wild animals for their use in cultivations in the ted areas; he referred to elephant, eland, buffalo, and zebra. In ambique animals of the first three kinds had already been esticated.

The following conclusion was unanimously agreed to:—

(1) That the indiscriminate preservation of game and th progress of native and non-native agriculture could not hand in hand.

(2) That evidence had been given to the Conference whic showed that in Tanganyika, and possibly other parts Africa, indiscriminate game preservation was at the presen time intensifying the difficulties of the European settler an restricting the progress of agriculture; and, further, that had the effect of so segregating the native that his lands wer becoming exhausted and a condition was arising leading t his demoralisation and preventing his natural rate of increas

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CHAPTER VI.

GOVERNMENT CONTROL OF MARKETING.

Mr. KOCH read the notes* which had been submitted by th Chief of the Division of Agricultural Economics of the Union of Sout Africa (referred to in Agenda as T.C.(C)Ag.19).

The CHAIRMAN (Mr. Holm) stated that he would like to put o record their appreciation of the interesting note which had just bee read, which indicated the wide scope of the Division of Economics i South Africa.

Mr. SIMPSON said that in Uganda the only commodity i regard to which they had strict marketing regulations was cotton With cotton they exercised a very strict control and only allowed it t be bought by licence and at certain specified places. By this mean it was possible for any individual producer to market his own cotto and obtain his money for it. This method had been of great benefi in excluding many of the unnecessary middlemen.

Mr. KIRBY stated that there were three main systems of auctio markets for produce in Tanganyika:—

(1) Markets, such as that at Morogoro, where only genera produce was sold, and deliveries were sold by auction o the previous day: this method eliminated the smal speculator.

(2) Markets which handled domestic products only, and wher each native brought his own produce to the auctioneer an paid a small fee to the Market Master. Special regulation were enforced as a precaution against fraud.

(3) Bulk Marketing. In this case truck loads were put up fo auction, and the whole transaction was under the supervisio of the Market Master, under the Administration, native being paid for their quantities delivered, according to th successful bid.

* For text of these notes see Appendix.

In all these markets the principle of auction was the guiding tor; and they were all managed by salaried market masters. There re of course open markets, in addition, managed by either a salaried rket master or a lessee, the latter system however leading to ud and neglect of care of markets.

Mr. KIRKHAM said that in Zanzibar, Government took 25% of clove production by way of duty, and this percentage of the cloves s sold by Government auction once a week. Apart from this ction, conditions in regard to marketing in Zanzibar were extremely satisfactory. The small shopkeeper, who holds a licence, was the ief supplier of small commodities, and he encouraged the natives mortgage their clove harvest. Licences were necessary in order to l cloves, copra, coconuts, etc., but anyone could obtain a licence a nominal fee, and the number of licences were too great for careful pervision to be exercised. A reduction of middlemen was very cessary in Zanzibar, and he would be glad if other delegates would vise him as to the best method of effecting this.

Mr. SIMPSON advised that cloves should be taken out of the linary category of Agricultural products, and that a special licence ould be necessary, say, of £5, in order that a man might be allowed deal in cloves. It would seem advisable to attempt to obtain nplete control of the clove market and to introduce regulations nfining the sale of cloves to specified places.

Mr. KIRBY said that the essential thing was to licence the place purchase rather than the purchaser.

In reply to Mr. Wood, he stated that in most cases the produce rkets in Tanganyika Territory were self-supporting.

CAPTAIN SHEEDY stated that, in Tanganyika Territory, live-k sales were controlled by the Veterinary Department. Definite kets or sites for stock sales were laid down by the local Veterinary er (with the Chief Veterinary Officer's approval) in collaboration the Administrative Officer, and sales outside these regulated sites prohibited. Such procedure was instituted mainly as a measure rds the control and eradication of animal diseases, and its success now manifested by the complete absence of rinderpest in the cts to which it had been applied. He mentioned that European ers in one district had opposed the scheme and were now vouring to secure exemption for European stock farmers, as they sidered it too restrictive.

The CHAIRMAN (Mr. Holm) stated that he was much impressed the description of the marketing methods in Tanganyika Territory, ch seemed to be in the interest of native producers and of merce generally. It must be borne in mind, however, that mercial interests are constantly pressing for freedom of operation the subject of marketing.

Mr. WORTLEY explained that the Native Tobacco Board was ged in considering measures for the control of the native tobacco stries with the main object of maintaining the quality of saland tobacco.

CHAPTER VII.

TRANSPORT PROBLEM.

Mr. KIRBY said that the problem of the transport of agricultural produce from local marketing points to the railway or the coast was in an interesting and difficult stage in many parts of East Africa. So much reliance had been placed on the time-honoured method of porterage that the recent rapid diminution in numbers of native porters, owing to increasing opportunities of a better livelihood in production or in plantation labour, had left transport in a situation of deficiency which, in many parts of East Africa was acute and critical. In some parts it called for swift remedy in which Government must lead. Railway construction was not enough: its subsidiary transport communications must be created or repaired to give the remedy full weight. Governments should, it is felt, go further by indirect assistance of private enterprise in introducing mechanical transport. The position was serious enough to call for such aids as exemption from Customs Duty on motor lorries, and low railway rates on these and on motor fuel.

Information as to the experience of other countries in the use of light railways and differing forms of mechanical transport, such as road-rail, would be welcomed.

(The above was circulated in the form of a Note under T.C.(C)Ag.16).

He thought the matter of the high price of fuel was already under the attention of the Kenya Government, where it was felt that a great deal of the high cost was due not so much to the cost of transport by sea or road as to action among the producers themselves, which was another matter. But they did feel in Tanganyika that Government might do something to assist (among others) those who were putting fleets of motor lorries on the roads.

Mr. WORTLEY said that in Nyasaland an effort had recently been made to reduce the cost of petrol. Government had taken 6d. off the duty on a gallon of petrol and the Railway had reduced the freight rate by the same amount.

Mr. SIMPSON stated that the McIlwaine press for pressing cotton was being tested by Uganda for the benefit of other East African territories.

Mr. KOCH stated that the motor lorry service in outlying parts of South Africa was of the greatest benefit to the community and operated most successfully. In a great many cases the services had proved profitable and indicated where it was likely that branch lines would prove successful.

M. VAN DEN ABEELE said that in the Congo a service of motor lorries running on charcoal as fuel was in operation. This service had been most successful and had proved to be most economical.

The CHAIRMAN (Mr. Holm) felt sure that they would all agree that cheap transport was essential for areas not served by railways. In this connection Kenya was not so badly placed as neighbouring

tories as it was able to use oxen for transport purposes and ubtedly for the movement of produce of ordinary value, it was eat advantage to possess ox transport.

With regard to the suggestions made by Mr. Kirby, he noticed Mr. Kirby wisely used the word " aids "; the position in Kenya that motor lorries did come in free of Customs duty. The other ct of the case had been discussed by the Economic and Finance mittee and evidence had been brought before that Committee h indicated that the prime cost of fuel oils landed at Mombasa, pared not unfavourably with the price at which similar fuel oils landed at South African ports. They, therefore, did not see a case could be made against the supplying companies, having rd to the conditions under which they had to supply the oil; but as noted that the railway freight rates represented a considerable ortion of the cost and that there was an enhanced cost in supplying il to the consumer by the manner in which it was supplied. With rd to the railway rates, he stated that as far as the Kenya and nda Railway was concerned the rates compared favourably with South African rates and that if the administration reduced the rates, say by two classes, on petrol and kerosene, it would lose enue approximately of £50,000 or £60,000 a year. The Economic Finance Committee recommended that the Railway Administra- should consider the reduction of the rates. Substantial help l also be afforded through carriage of oils in bulk and installations upply in bulk instead of in tins. One company in particular was sting itself in the provision of bulk supplies at important centres he Railway Administration was offering the necessary facilities. as hoped in that way, to some extent anyway, that the cost of oils would be reduced.

The other suggestion made by the Economic and Finance mittee dealt with the Customs and Excise duties. One had to t the subject from the different points of view. If the Customs on petrol or kerosene, or both was reduced a large amount enue would be lost and it was not considered practicable to it on petrol and kerosene used for agricultural purposes without ng it for the whole community and a large percentage of the consumption of these oils was used for other than agricultural ses. The Economic and Finance Committee had made a mendation that the excise duty on petrol should be removed at the revenue derived therefrom should be obtained in another with exemption of agricultural tractors used on farms.

Mr. KIRBY stated that transport by mechanical means was tant in Tanganyika owing to the existence of tsetse fly which nted the use of oxen, but that what Mr. Holm had said with l to the position in Kenya cleared the matter up.

Mr. MILLIGAN said that trials had been made by a special mittee of the Empire Cotton Growing Corporation with various of road transport. That Committee came to the conclusion the semi-caterpillar type of tractor was the most suitable for al conditions. Further trials were now being undertaken in ern Nigeria to decide between indiarubber and metal tracks.

Discussion ended with the passing of the following conclusion:—

That, having regard to the difficulties of transporting agricultural produce to the Railway systems and the heavy cost thereof it is desired to invite the attention of the Governments of the East African Territories to the importance of reducing the capital and running costs of motor vehicles, in particular, by every means within their power.

CHAPTER VIII.

TEMPORARY EXCHANGE OF TECHNICAL SPECIALISTS.

Mr. KIRBY read a note* on this subject (referred to in Agenda as T.C.(C)Cot.11) and explained that he had raised this question in order to obtain the opinion of the Conference on two points:—

(1) As to whether it was advisable to have such a system of exchanges; and

(2) Whether the organisation of any such system might be advised.

After some discussion, in which Messrs. Holm, Fuller, Wortley Simpson, Kirkham and McDonald took part, it was agreed:—

That the temporary exchange of technical specialists between Dependencies in East Africa is, in present circumstances inadvisable. It is emphasised that the temporary attachment of specialist officers of one dependency to another for special work is most valuable, and further that greater facilities for visits by Specialist Officers to neighbouring Dependencies should be accorded by Governments.

CHAPTER IX.

CO-OPERATION BETWEEN TECHNICAL SPECIALISTS AND GENERAL EXECUTIVE AGRICULTURAL OFFICERS.

Mr. KIRBY read the following statement (referred to in Agenda as T.C.(C)Cot.10.)

The technical specialists principally in mind are those engaged in work for cotton.

Both these and the agricultural officers with whom they are to work must be made acquainted with the policy of the Agricultural Department and its methods of procedure.

* For text see Appendix.

Technical specialists have nothing to do with the framing of such
y or procedure. This is a matter lying between the Director of
culture and the Government which he serves, with due regard to
desires of, and co-operation with, institutions (such as the British
on Growing Association and the Empire Cotton Growing
oration) organised at home for large treatment of the work in
: institutions which may or may not assist with provision for the
ly of the technical officers concerned.

Where technical officers are supplied by such institutions as the
e, their work will of course be devised according to the wishes of
e institutions, which will doubtless desire to consult the Director
griculture concerned, before deciding the matter. These technical
ers will submit their schemes of work, based on the general plan,
ie Director, for consultation.

In such a case as this, if the technical officers are using part of
agricultural station belonging to the Department of Agriculture,
rience has shown that the labour required for their work should
llocated to those officers by the agricultural officer in charge of the
on, on a scale decided in mutual consultation, with reference to
Director of Agriculture if and as required. It has shown, further,
it is best for the agricultural officer to be in general charge of
abour employed, recruiting, care of labourers, payment of wages,
all being in his hands alone, with the manifest exception that
nical officers will obtain any skilled labour that they may wish
and that may be available, the care, etc., of such labour being
ie hands of the Agricultural Officer, as for ordinary labour.

Where technical officers are supplied from the funds of an
cultural Department, the control of them and their work will be
respects the same as that for ordinary agricultural officers.

Where there is allotted to such officers for their work part of a
al agricultural station, the care, etc., of the labour will be in the
of the agricultural officer as above, the division and supply of
being decided among those officers in mutual consultation with
nce as requisite, as described already.

Technical specialists provided institutionally (see above) will
to the supplying institution, with copies to the Director of
lture who will comment and recommend on them to the
hief Secretary who will in turn communicate the comments, etc.,
Secretary of State for transmission to the institution concerned.
nical specialists supplied Governmentally will report in the
er of an ordinary agricultural officer.

n the case of technical specialists provided institutionally at
and then acquired by Government after a period of time, it seems
hat after such acquisition copies of their reports should continue
supplied direct to the institution originally providing them, and
the institution in question should continue to possess the right
mment and recommend on such reports, as considered requisite,
h the Secretary of State, the Director of Agriculture concerned
through his Government any requisite information and the
s why any activities under the above recommendation have not
or will not be undertaken.

It will be of interest to learn of the experience in these matters of other Dependencies where technical (cotton) officers have been or are being employed.

Mr. WORTLEY expressed the view that co-operation between unofficial technical specialists and the Agricultural Department would be best effected by arranging a complete division of responsibility. He thought, for instance, that the work of the Empire Cotton Growing Corporation should be confined to investigational and experimental work, and that the work in connection with the expansion of the industry should be in the hands of the Agricultural Department, who should arrange for the dissemination of any seed which might be supplied by the Corporation. He was only too glad, of course, to have advice from the technical specialists, but he thought that their zone of work should be clearly defined. Stations in which such technical specialists were working should be entirely under their own control.

Mr. MILLIGAN explained that he was not representing the Empire Cotton Growing Corporation in this matter, but that his personal view of the question was in agreement with that of Mr. Wortley. He thought that the separation of stations would avoid any chance of friction, which might otherwise arise.

Mr. CAMERON stated that the position in Southern Rhodesia was quite contrary to the views which had been put forward. There, everything connected with cotton was placed before the Corporation representative by the Department of Agriculture. The Government felt that the closest co-operation between Government and the Corporation was best effected by placing most of the cotton work in the hands of the Corporation: results have been extremely satisfactory. He went on to say that in making that statement he was speaking for the Government of Southern Rhodesia and not for the Corporation, and that he was of opinion that no resolution on this matter should be put forward but that each territory should solve its own problem as it thought best.

Mr. MILLIGAN agreed with Mr. Cameron that it was not possible at present to stipulate any particular method, but in looking forward to the future role of the Corporation he thought that the tendency would be more and more toward research work and investigation.

The CHAIRMAN (Mr. Holm) drew attention to some of the difficulties entailed in providing stations for the work of cotton specialists alone.

Mr. SIMPSON emphasised the necessity for the fullest co-operation in such matters. He stated that one must not lose sight of the fact that the ultimate responsibility in such matters must rest with the Government Departments concerned.

The CHAIRMAN (Mr. Holm) referred to the proposals in regard to research by the Rowett Institute at Aberdeen, which were shortly going to be carried out in Kenya; and he stated that, in that case, the staff was supplied by the Institute through the Civil Research Committee for a special investigation and that the Kenya Government was responsible for certain local expenditure. He did not think that it was possible to lay down precisely in " black and white " the exact

ethod by which co-operation could and should be effected, as rsonal factors, of necessity, entered into the question, and were ten the most important.

He understood that the position in regard to the Empire Cotton rowing Corporation was that work in Africa had not progressed far ough for them to define clearly their line of work but that the ndency was for them to confine their attention as much as possible research work.

CHAPTER X.

CO-OPERATION BETWEEN DEPARTMENTS OF AGRICULTURE.

Mr. WORTLEY said that many matters which he had in mind hen he asked for this item to be put on the Agenda had already been scussed, and arrangements had been made for such action as he had mind, and there were only one or two points which he now wished bring up. He felt strongly that this Conference had been very ccessful, and that they should formulate some definite scheme in der to ensure continuous results. A further difficulty in putting a finite scheme before the Conference was due to the fact that veral of the points which he had intended to bring up were dependent the establishment of Amani, and there were only two matters which would now like to have discussed.

Firstly, he thought that it would be of great advantage to pical Agriculture in the East African Territories if a permanent mmittee in England were instituted, which would take an interest the progress of African tropical agriculture; and he suggested that r. Holm be asked to make enquiries when he went to England on ve as to the advisability and practicability of this proposal.

Secondly, it must be admitted that literature on the Agriculture East Africa was at present very inadequate, and that definite steps uld be taken to improve this unsatisfactory state of affairs.

Closer co-operation between the local Departments of Agriculture s desirable and would, he felt certain, be brought about as a result this Conference.

Mr. HOLM agreed, in principle, with Mr. Wortley's suggestion, was not in favour of the appointment of a Committee at home, ess it were composed of people with a knowledge of local African ditions and the administration of Departments of Agriculture. present, probably, such people could not be found, but if, at a later te, it should be found possible, he thought that the Committee uld be very useful. If he could help in any way when he was on ve he would be very glad to do so. He would mention that there is at present in existence a Committee appointed by the Secretary State to advise him with regard to the training of officers for the illing of Agricultural Departments in the Crown Colonies, and that y had been discussing other matters of interest to Agricultural partments and the industry which they serve.

In regard to literature, he would say that there was no more ctical way of co-operation among territories than interchange of d agricultural literature, and he hoped the position in this respect uld soon be considerably improved.

Mr. SIMPSON also agreed with Mr. Wortley, in principle, though he was somewhat doubtful of the uses of a Committee in London, such as that suggested. He thought that possibly their needs could best be served by the appointment of a sub-committee of the Committee of Civil Research for East African Tropical Agriculture, if that were possible.

The question of formulating a definite scheme for the establishment of a body that would be representative of local Departments of Agriculture was discussed, and it was decided:—

That no conclusion could be reached in this matter until further progress had been made in regard to the establishment of Amani Institute.

CHAPTER XI.

AGRICULTURAL JOURNAL.

Mr. HOLM read a paper* on the establishment of an Agricultural Journal for Eastern Africa (referred to in Agenda as T.C.(C)Ag.1). He said that if the publication of the journal were undertaken by the Amani Institute he thought that the appointment of an Editor at Amani would strengthen the staff there, and that, at a later date, Amani would be in a position to publish scientific memoirs. He hoped that, as a result of the present Conference, an Agricultural Journal for East Africa would soon be published regularly.

Mr. KIRBY thought that individual Governments should subscribe to a central editorial and publishing department, the material for publication being provided mainly by the technical departments concerned. It was likely that the Amani Institute would, in time, have its own scientific journal, and it might be convenient for the headquarters of the East Africa Journal of Agriculture to be established there from the beginning, since later it would be economical for a combined journal, or both journals to be conducted by a single editorial staff.

(The above was circulated in the form of a note under T.C.(C)Ag.11.)

Mr. SIMPSON thought that the journal should be published at Amani, and that the Institute should do it as part of their normal duties. He did not wish to submit to Government a proposal for a contribution to Amani for the journal, in addition to the ordinary lump sum contribution.

Messrs. Burton and Beckley were doubtful as to whether Amani ought to undertake the publication; and Mr. Kirby pointed out that the Research Institute at Trinidad publishes a journal such as that contemplated.

Mr. HOLM thought that the editor of the journal should be appointed, as soon as the Governments had agreed to a scheme, and that publication should not necessarily be deferred until Amani was established. In Kenya the question was one of great importance and a pressing need, and he would like to see it carried out as soon as possible.

* For text of paper see Appendix.

Messrs. Kirby, Simpson, and Kirkham thought that there was no great urgency in the matter, and that it would be best to defer until something more was known about Amani.

After further discussion it was agreed that:—

(a) The publication of an East African Agricultural Journal was necessary.

(b) An East African Agricultural Journal should be issued from Amani, and that its production should be one of the normal functions of that Institute, when re-established.

(This second conclusion was passed by a majority of eight to six.)

CHAPTER XII.
AMANI INSTITUTE.

Mr. WORTLEY said that he had raised the question of the ionship of Amani Institute to local Departments of Agriculture, n Nyasaland they were somewhat in the dark as to the proposals the re-establishment of Amani.

The CHAIRMAN (Mr. Northcote) observed that the whole tion was being carefully discussed in England, and that the etary of State had intimated that he had not accepted the mmendations of the " Schuster " Committee so far as Amani was arned.

Mr. KIRBY said that it had been known for some time that the nial Office was in process of appointing a Director to Amani, and ound it somewhat difficult to discuss the question until the ctor was found. He had hoped that a Director would have been inted, and that he would have been present at the Conference; it was with that in view that he had raised certain questions in d to the future use of Amani Institute. He understood that it ntended that the Director, when appointed, should organise the tute himself; and in his absence he felt that they could not ss the subject in full.

Mr. SIMPSON thought that the Conference ought to know the ance of the Report of the Committee of Directors of Agriculture 20. Recommendations which were then made appeared to have lost sight of, and he considered these to be of the greatest rtance, and that the relation of Amani to the Departments of ulture was of importance not only to the Departments themselves to the whole development of agriculture in the East African tories.

The Secretary informed the Conference that the recommendations ained in Sir David Prain's Report and the Report of the Directors griculture had been considered at the Governors' Conference in uary, 1926, when the question of Amani and research in ral was discussed.

Mr. HOLM hoped that all Directors of Agriculture would adhere principles embodied in their Report on Amani, dated December, , and that the other delegates would also support those principles. e could be no doubt, he thought, that the site of Amani was, in ral respects, not wholly suitable for such an institution, and that

Mr. BECKLEY said that there were two main classes of investigation, *i.e.*:—

(1) Those necessary in each territory which were mainly of local interest; and

(2) Those affecting more than one territory of fundamental importance.

For investigations falling under the first category, local knowledge was essential; it would be impossible for technical officers at a central research station to have the required knowledge. Furthermore, if all scientific officers were transferred to Amani much of the work of the Institute would be routine and the staff would have to be very large as otherwise the research work would suffer. Amani should investigate items of fundamental importance, which scientific officers of the various territories were unable to investigate owing to pressure from local problems.

Mr. KIRKPATRICK, in reply to Mr. Hargreaves, stated that he considered that one of the normal functions of an Institute, such as Amani, would be, for instance, research into the tropisms of insects. Research such as this was outside the scope of officers of Agricultural Departments, and they had neither the time nor facilities for undertaking it. In a subject such as this, no results could probably be achieved in two or three years, but the effect of ten or fifteen years of continuous work would be extremely valuable.

Mr. KIRKHAM said he had given very considerable attention to science and agriculture, and their organisation. They were on the verge of a great expansion of scientific research throughout the Empire. Science was organised knowledge but in itself it lacked organisation at present; eventually this organisation must come, and it was important that the question should be very carefully considered. He agreed that Amani could not possibly undertake all research in the East African territories, and it was difficult to formulate a scheme for the complementary work which it should carry out, as it would find it difficult to satisfy everyone if all territories had a claim on Amani staff. Considerable funds would be placed at their disposal from the ten million loan, and they must find the best means of making use of it.

Directors of Agriculture could not agree to a reduction in their present services; at the same time entomologists, mycologists, chemists, plant breeders, etc., all felt that something should be done to co-ordinate their work. The staff at Amani would presumably include representatives of every branch of agricultural science, and it should fall to them to co-ordinate the work in the different territories. Ultimately, this organisation would lead up to a general scientific service for East African territories, and the scientific staff would become officers of a comprehensive service, whose headquarters should be well equipped with laboratories, where officers could be sent to carry out work which was not possible locally, owing to lack of facilities. Furthermore, such a comprehensive service would give improved prospects to the scientific officer.

Mr. BURTON considered that the best use for Amani would be in carrying out such research work as the various Dependencies required, but that it should not be in a position to dictate to Departments of Agriculture as to what research should be carried out. He

ought that it was opportune that a conclusion on these lines should passed by the Conference.

Mr. SIMPSON stressed two points: Firstly, that the greater the ff that was working at Amani, the greater would be the requirement the various territories for scientific men; secondly, that it must be lerstood that no Director of Agriculture, who was responsible to Government, could hand over such responsibility to any institute— wever eminent it might be.

Although he had stated that he agreed with the Chairman's posal to defer a conclusion by the Conference, he thought it would useful if a vote of confidence in the Report of the Directors of riculture of 1921 were taken.

The following Committee representative of Departments of riculture, including scientific officers, was appointed to draft a nclusion in keeping with the concensus of opinion of the Conference:

Mr. Holm (Chairman), Messrs. Simpson, Kirby, Wortley, rkham, Parnell, Koch, Hargreaves, Ritchie, Beckley, Burton, and cDonald.

The following conclusion, submitted with the unanimous approval the Committee, was endorsed *nem. con.* by the Conference:—

(a) That the re-opening of Amani under a competent Director is likely to be of value to East Africa, provided that its activities are confined to those for which the natural resources of the Institution render it suitable.

(b) It is desired to emphasise the principle that the activities of Amani should be concerned primarily with fundamental research work, designed to supplement and in no way to supplant the work of the scientific officers of the Departments of Agriculture in the East African Territories.

(c) Further, it is recommended that the organisation should not be laid down until the Director has had an opportunity of studying the conditions and requirements of these territories, and the methods which should be adopted for the co-ordination of research work.

CHAPTER XIII.

PUBLICATION OF REPORT.

The form of the Report was discussed, and it was agreed to leave s matter to the discretion of the Secretary, it being understood that e Report would be divided into four Parts, *i.e.*:—

(1) Agriculture.
(2) Cotton.
(3) Entomology and Mycology.
(4) General.

d that the more important papers should be included in the records proceedings; those of less importance, which had been submitted th a view only to promoting discussion, being placed in an Appendix. was the general opinion that probably about 1,000 copies of the oceedings would be required.

CHAPTER XIV.

SUMMARY OF CONCLUSIONS IN PART V.

1. Amani.
   (a) That the re-opening of Amani under a competent Director is likely to be of value to East Africa, provided that its activities are confined to those for which the natural resources of the Institution render it suitable.
   (b) It is desired to emphasise the principle that the activities of Amani should be concerned primarily with fundamental research work, designed to supplement and in no way to supplant the work of the scientific officers of the Departments of Agriculture in the East African Territories.
   (c) Further, it is recommended that the organisation should not be laid down until the Director has had an opportunity of studying the conditions and requirements of these territories, and the methods which should be adopted for the co-ordination of research work.
2. Publication of an East African Agricultural Journal.
   (a) That the publication of an East African Agricultural Journal is necessary.
   (b) A majority agreed that an East African Agricultural Journal should be issued from Amani, and that its production should be considered to be one of the normal functions of that Institute when re-established. (This conclusion was passed by a majority of 8 to 6, the remaining members of the Conference abstaining from voting.)
3. Joint East African Agricultural Show.

That as the question of a joint East African Agricultural Show is now before the Governments concerned, it is inadvisable to submit any definite conclusion. Should the Governments concerned favour the proposal, the Directors of Agriculture undertook to give all facilities within their power.

4. Exchange of Technical Specialists.

That the temporary exchange of technical specialists between Dependencies in East Africa is, in present circumstances, inadvisable. It is emphasised that the temporary attachment of specialist officers of one dependency to another for special work is most valuable, and, further, that greater facilities for visits by specialist officers to neighbouring Dependencies should be accorded by Governments.

5. The Preservation of Game.
   (a) That the indiscriminate preservation of game and the progress of native and non-native agriculture could not go hand in hand.
   (b) That evidence had been given to the Conference which showed that in Tanganyika, and possibly other parts of Africa, indiscriminate game preservation was, at the present time, intensifying the difficulties of the European settler and restricting the progress of agriculture; and, further, that it had the effect of so segregating natives that their land was becoming exhausted, and a condition was arising leading to their demoralisation and preventing their natural rate of increase.

PART VI.

Summary of Conclusions

AND

Concluding Speech by the Chairman.

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PART VI.

MMARY OF CONCLUSIONS AND CONCLUDING SPEECH BY THE CHAIRMAN.

CHAPTER I.

MMARY OF THE MORE IMPORTANT CONCLUSIONS AND RECOMMENDATIONS ADOPTED BY THE WHOLE CONFERENCE.

GENERAL.

AMANI.

(a) That the re-opening of Amani under a competent Director is likely to be of value to East Africa, provided that its activities are confined to those for which the natural resources of the Institute render it suitable.

(b) It is desired to emphasise the principle that the activities of Amani should be concerned primarily with fundamental research work, designed to supplement and in no way to supplant the work of the scientific officers of the Departments of Agriculture in the East African Territories.

(c) Further, it is recommended that the organisation should not be laid down until the Director has had an opportunity of studying the conditions and requirements of these territories, and the methods which should be adopted for the co-ordination of research work.

PUBLICATION OF AN EAST AFRICAN AGRICULTURAL JOURNAL.

(a) That the publication of an East African Agricultural Journal is necessary.

(b) A majority agreed that an East African Agricultural Journal should be issued from Amani, and that its production should be considered to be one of the normal functions of that Institute when re-established. (This conclusion was passed by a majority of 8 to 6, the remaining members of the Conference abstaining from voting.)

JOINT EAST AFRICAN AGRICULTURAL SHOW.

That as the question of a joint East African Agricultural Show is before the Governments concerned, it is inadvisable to submit definite conclusion. Should the Governments concerned favour proposal, the Directors of Agriculture undertook to give all ities within their power.

EXCHANGE OF TECHNICAL SPECIALISTS.

That the temporary exchange of technical specialists between ndencies in East Africa is, in present circumstances, inadvisable. emphasised that the temporary attachment of specialist officers e dependency to another for special work is most valuable, and, er, that greater facilities for visits by specialist officers to bouring Dependencies should be accorded by Governments.

5. The Preservation of Game.

(a) That the indiscriminate preservation of game and the progress of native and non-native agriculture could not go hand in hand.

(b) That evidence had been given to the Conference which showed that in Tanganyika, and possibly other parts of Africa, indiscriminate game preservation was, at the present time, intensifying the difficulties of the European settler and restricting the progress of agriculture; and, further, that it had the effect of so segregating natives that their land was becoming exhausted, and a condition was arising leading to their demoralisation and preventing their natural rate of increase.

AGRICULTURE.

1. Manures.

That the attention of the Governments of East Africa be drawn to the possibility of the existence of deposits useful as fertilisers in the various territories, and that such Governments be asked to consider the recommendation that their respective Geological Departments should make this matter a prominent subject in their normal investigation and report.

2. Transportation of Stock.

(a) On the statement presented by the Trades Commissioner for South Africa, it is noted that the freight and other charges on stock imported from South Africa are considerable, and it is requested that the Trades Commissioner should make representation with a view to effecting reductions.

(b) It is considered that the rates on livestock from England to East African ports are excessive, are limiting the importations of stock, and are, therefore, retarding livestock improvement in East African territories. It is, therefore, urged that representations be made to the Shipping Companies requesting that a substantial reduction be offered.

3. Compulsory Dipping of Cattle by Natives.

That under existing conditions the compulsory dipping of cattle by natives is, at present, impracticable over extensive areas.

4. Wheat Cultivation by Natives.

That wheat growing by natives should be encouraged in areas suitable to the crop, not only for improving the food ration for the native population, but also for production for purposes of sale when satisfactory transport conditions exist.

5. Prevention of Adulteration.

(a) That the principle of official compulsory grading and/or inspection of agricultural produce, prior to export, is sound and should be applied wherever practicable in the interests both of producer and the trade.

(b) That, in order to give effect thereto, legislation is essential.

(c) That charges calculated to cover the cost of the grading and/or inspection service should be levied.

(d) That in cases where it is found impracticable for the inspector to perform the grading the onus should be placed upon the owner or shipper to grade or prepare the product, in accordance with the standards laid down; in such cases, the service may take the form of inspection only of the whole or a prescribed proportion of the shipment.

(e) That in the case of grading and/or inspection under such legislation, official certificates as to grade or standard of quality should be issued where expedient.

(f) That the legislation should take the form of a general enabling Ordinance, following the examples of South Africa and Kenya, with provision for the application of the Ordinance to any particular product, and the framing of rules dealing specifically with the grades or standards, and the services of grading or inspection or both.

6. Transport.

That, having regard to the difficulties of transporting agricultural produce to the railway systems and the heavy cost thereof, it is desired to invite the attention of the Governments of the East African Territories to the importance of reducing the capital and running costs of motor vehicles, in particular, by every means within their power.

7. Native Agriculture.

(a) It is desired to impress upon the Governments of East Africa the great importance of a pronounced agricultural bias being given to the education of Africans in these territories, where agriculture is almost the sole industry upon which the sustenance and advancement of the African peoples depend —a principle which has already been emphasized by the Phelps-Stokes Commission.

(b) It is further considered that, for the development of native agriculture, a staff of Africans trained in agriculture and capable of performing the duties of agricultural instructors is essential; and it is urged that the necessary provision should also be made for the systematic training of African teachers in agriculture for schools in native areas.

COTTON.

1. Technique of Field Experiments.

That whatever method of field experiment was used it should be so designed as to permit the degree of accuracy being determined.

Attention was also called to the inaccuracy which may be involved in comparing varieties which are different in habit and which may, therefore, be differently affected by the cultural conditions adopted, *e.g.*, uniformity of spacing for large and small types is obviously unsound.

2. The Keeping and Utilisation of Records.

That the keeping and utilisation of records with regard to the Cotton plant and its yield necessitates Experimental Stations being adequately equipped.

3. The Position with regard to Cross Breeding.

That crossing ought to be valuable, but in practice it does not appear to be so. If crossing is to be of value, an early start should be made, since a long time elapses before any results are achieved.

4. The Treatment of Seed before Sowing.

That the sulphuric acid treatment for seed for de-linting should be fully investigated by some central institute, if local investigation proved insufficient.

5. Mass Methods for Maintaining and Improving the Quality of Cotton in the Districts.

That mass selection must be only a temporary measure during the time necessary to establish pure strains.

6. Interchange of Strains between African Countries.

(a) That the Empire Cotton Growing Corporation be asked to prepare and publish, and keep up to date, a list of all varieties and strains of cotton in cultivation throughout the world, with a description of the characteristics of each variety, and the conditions under which it is grown.

(b) That with a view to guarding against the disappearance of any particular strain, showing specialised qualities, such should be stored locally against possible requirements.

(c) That a uniformity of nomenclature of strains in Africa is advisable; so far as South and East Africa are concerned, it was considered that new productions should be distinguished by the name of the producing station, followed by a distinguishing number or letter, or both.

7. Introduction of new varieties from Countries outside Africa.

(a) That much benefit would accrue from the broadening of the basis of selection by the introduction of promising varieties from outside, especially from America.

(b) That the Empire Cotton Growing Corporation be asked to assist Plant Breeders in obtaining such varieties as they may require.

8. Methods of Testing New and Improved Strains of Cotton in different parts of the Country.

That it is useless to arrange for tests and records unless these are accurately carried out; any such tests should be carried out under the supervision of the Agricultural Department. Inspections, with notes, should be made as frequently as possible, and, in any case, at intervals not greater than one month; regular periodic pickings should also be made, if possible. Where sufficiently competent men are in charge, meteorological records should also be kept.

9. Cotton Tax.

That it is desirable that, in the imposition of a Cotton Tax, the principle of a graduated tax, having regard to the market price of cotton, be adopted.

ENTOMOLOGY AND MYCOLOGY.

Cotton Pests.

1. That the *Platyedra erebodoxa*, Meyr (M.S.), discovered by Mr. Hancock, shows no indication of becoming a pest of cotton in Uganda.

2. (a) That steps be taken to secure from each African territory a report upon the presence or absence of Pink Boll Worm therein, together with a carefully prepared map showing the different cotton growing districts; and, if Pink Boll Worm is present, the areas known to be infested.

(b) That, from the information so supplied, a map of Africa be prepared for the use of African Entomologists, showing the distribution of cotton cultivation and of Pink Boll Worm.

(c) That the delegation from South Africa, as represented by the Government officials and the officials of the Empire Cotton Growing Corporation, be asked to initiate this project and secure the publication in South Africa of the desired map for distribution.

3. That although a great deal of experimental and investigational work has been done on Sudan, American and Spiny Boll Worms, this Conference is not in a position to make any general recommendations. No economic means of control have yet been devised but the Conference is of opinion that further investigations are desirable and necessary.

4. That there is danger of *Apion* becoming a serious pest if uprooting and burning is not resorted to, and that in Tanganyika uprooting and burning has been found to be entirely successful.

5. That the status of the wild food plants of the Sudan Boll Worm is of great importance and calls for further thorough investigation.

6. That the control of *Aphids* and *Jassids* by fungi should be further investigated.

7. That a wider survey is necessary before any definite information can be supplied in regard to the natural occurrence of major pests, and their occurrence under conditions of cultivation.

8. That, in view of the immense importance of Cotton Staining and Internal Boll-rots to the future development of Cotton growing in Africa, it is recommended:—

(a) That thorough investigations should be undertaken into the problem, with special reference to the possible role played in transmission by *Dysdercus* and other suctorial insects.

(b) That in some one centre an adequate staff should investigate thoroughly the whole problem in all its aspects, and that the Government of South Africa should be approached, in the first instance, with a view to undertaking this work.

(c) That the programme of the work to be adopted should be drafted by the staff of the centre chosen for the major investigations.

(d) That this programme should be circulated to the Departments of Agriculture in other Cotton growing areas, with a view to complementary work being undertaken by them.

General Entomology and Mycology.

9. That much more work should be done by Entomologists in regard to the *Pheidole* ant, and that the question of baits and the destruction of nests is worthy of close investigation. As this ant was of great importance in Kenya, it was recommended that a thorough investigation should be undertaken in Kenya.

10. That the Entomologists of Kenya and Uganda should meet and discuss the question of preventing the spread of *Stephanoderes hampei* into Kenya after visiting Coffee areas to the east and west of Mount Elgon.

11. That the conditions and problems in South Africa are so entirely different from those in tropical East African Colonies that the problem of the control of Cut-worm is one for solution in the various territories concerned.

12. (a) That each participating territory should arrange to prepare lists of injurious insects and fungoid diseases, with their food plants and status as pests, and to interchange such lists.

(b) That, in order that the lists may be uniform, they should be compiled in the following form: (a) Name, (b) reference to original description, (c) distribution, (d) food plants and alternative hosts, (e) status as a pest, (f) predators and parasites, (g) further notes.

(c) That the Imperial Bureau of Entomology and Imperial Bureau of Mycology in London should be approached with a view to the compilation, classification and publication of the lists by them.

13. That each Department of Agriculture of South and East African Territories should undertake to notify, without delay, every other such Department of the presence of a new disease or pest considered to be of economic importance.

14. That a study should be made of the insecticidal properties of native plants.

15. That uniform legislation should apply to importation of plants and seeds into Kenya and Uganda.

CHAPTER II.

CONCLUDING SPEECH AND FINAL RESOLUTION.

The CHAIRMAN (Mr. Northcote): Now that you have approved the various conclusions and recommendations which have been put up to you by the various sections, I think that your labours are concluded and it appears to me that one can only consider that the result is satisfactory, for of all the conclusions that have been before you there is only one which has not been unanimously accepted, and that, which deals with the place of publication of an East African Agricultural Journal, can hardly be considered to be a very essential one.

I regret that I have not been able to take the Chair more frequently during the Conference, but other urgent business has prevented me from doing so and I have been kept in constant touch with the work that has been done.

Such a Conference as this, with representatives from so many territories must be of great value to all concerned, not only from the official discussions which take place with regard to items on the Agenda, but also from those many unofficial conversations which take place between representatives from the different territories who are interested in the same subjects.

Kenya is proud and pleased that this representative Conference—the first of its nature in East Africa—should have been held at Nairobi, and, as our President remarked in his opening speech, I think we are all of us indebted to the Secretary of State and also to the Governors' Conference for convening it. I think that we should all thank the Secretary of State for his foresight in issuing instructions that the preparation of the Agenda and the arrangements for the conduct of the Conference should be made by the Secretariat of the Governors' Conference; one of the many advantages to be derived from the employment of that disinterested office—if I may so describe it—for such a purpose is that it ensures the Conference from any subsequent reproach that undue prominence was given to any particular problem.

To my mind there is no doubt that there has throughout been a splendid spirit of co-operation and that everyone has worked together with the greatest desire to solve the problems before the Conference. The valuable and unanimous conclusions which have been reached I hope will be considered by the President to be sufficient to justify the remarks that he made in his opening address. This Conference marks a milestone on the road to common endeavour and common policy for the development of the immense natural resources of the Eastern and Southern half of the Continent of Africa, and I firmly hope that from this Conference results may be achieved which will be of advantage to the countries and places represented.

After your strenuous labours of these last few days I will keep you no longer. I trust that you have enjoyed your time in Kenya and hope that your work in the Conference rooms has not been so heavy that you have been unable to appreciate the beauties of the country during the tours which you have made and I hope that you will take away with you pleasant memories of this country.

The following final resolution was then adopted:—

That the thanks of the Combined Agricultural, Cotton, Entomological and Mycological Conference should be conveyed to:

1. The Secretary of State for convening the Combined Conference.

2. His Excellency the Governor of Kenya for accepting the position of President and to him and to the Government of of Kenya for their hospitality.

3. The Governors' Conference Secretariat for all the arrangements made in connection with the Conference.

4. The Hon. Alexander Holm, C.B.E., Director of Agriculture, Kenya, and the members of the staff of his department for their assistance and kindness during the period of the Conference.

5. The various Companies, Associations and individuals who had rendered assistance or shown hospitality to the Conference.

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APPENDIX

(A) NOTES ON VISITS.

Scott Laboratory.

On Tuesday, August 17th, the delegates to the Conference visited the Scott Agricultural Laboratories. After inspecting the Entomological, Chemical, and Mycological Laboratories, the various field experiments were inspected.

The important Plant-breeding work which is being done on wheat and maize was appreciated and the school gardens worked by the native agricultural pupils, also the model native holdings were viewed with favour.

Veterinary Research Laboratory.

On August 19th the delegates were conducted round the Laboratory in two parties under the charge of Mr. Daubney, the Ag. Chief Veterinary Research Officer, and Dr. Whitworth, the Ag. Asst. Chief Veterinary Research Officer. They were shown the processes involved in the manufacture of contagious bovine pleuro-pneumonia vaccine and were greatly interested in the cultures of the filtrable virus causing this disease. The method of carrying out the conglutination test for the diagnosis of chronic cases of bovine pleuro-pneumonia was also demonstrated. Great interest was expressed by the members of the Conference on inspecting the processes in the manufacture of anti-rinderpest serum of which the laboratory produces some 30,000 doses per month. The manufacture of various other vaccines and laboratory products was also demonstrated. The general system of diagnosis of specimens and smears (of which some 1,200 per month are received at the laboratory) was next examined. The results of current research work on Paratyphoid infection of calves, Bovine Lymphangitis, Streptothricosis and Laikipia Lung Disease of sheep were also demonstrated to the delegates, who afterwards visited the new wing now under construction and made a tour of the outside buildings including the houses for experimental animals. Tea was taken in the Library and the delegates left shortly before 5 a'clock.

Kyambu.

On Friday, August 20th, the delegates to the Conference were entertained by Mr. Douglas at Kassarini in the Kyambu District. The coffee manurial experimental plots were visited. The various systems of training the coffee bush were examined and the methods of pruning applied were demonstrated. An experiment which showed the beneficial effects of an artificial mulch on the growth of young coffee aroused interest. The factory was visited and the processes employed in the preparation of coffee for the market were explained.

Nakuru.

During the week-end August 21st to 23rd the delegates visited Nakuru under the auspices of the Kenya Farmers' Association. Tours were made of the Solai, Njoro, Rongai, and Lower Molo districts, and the Association kindly entertained the party to lunch at the Rift Valley Sports Club.

The type of farming chiefly seen was maize production on a large scale. The delegates were much impressed by the high quality and yield of the maize and the fertility of the soil, indeed with the great productive power of the whole area.

LIMURU.

On Wednesday the 25th August the delegates visited Limuru District, examining on the way agricultural methods employed by the natives in the Kikuyu Reserve.

At Mr. Pirie's stock farm a fine herd of Frieslands was inspected and the delegates expressed their admiration of the animals. The natural pasture of Kikuyu grass and clover evoked interest.

Subsequently a visit was paid to the Wattle Extract Factory, where the party was received by Mr. Johnson.

Young tea plantations were seen *en route*.

THIKA.

On Thursday, the 26th August, the delegates visited the Thika Sisal Estates at the invitation of Commander Lawford.

Here and in the district they saw extensive areas under sisal, and the several factory processes were demonstrated.

(B) PAPERS REFERRED TO IN THE REPORT.

(1) AGRICULTURAL JOURNAL FOR EAST AFRICA.

(Paper by Director of Agriculture, Kenya Colony—T.C.(C)Ag.1)

For the purpose of promoting the development of the Agricultural industry in East Africa steps should be taken to publish an Agricultural Journal.

2. Excepting perhaps Kenya, it is felt that no territory in East Africa is likely to be in a position to publish such an organ on its own resources, having regard to the contributions required to maintain it at a high standard, the cost of production and publication, and the number of subscribers likely to take the journal.

3. Agricultural conditions and problems in East Africa are interrelated, many forms of production are common to all and no better method is available of keeping officers of the Agricultural Departments of the different territories in close touch with the work of one another, and also of informing the public as to the work of these Departments, than through a publication of this kind.

4. For many years the South African and Rhodesian Agricultural Journals have rendered service of great value, and their counterpart should prove most useful in East Africa.

5. The following proposals are submitted for consideration:—

(a) *Title:* "The Journal of Agriculture of East Africa," or "The East African Agricultural Journal."

(b) To embrace articles on general agriculture, including stock, agricultural research and experiment, science as applied to agriculture, cognate subjects, *e.g.*, veterinary, forestry, building construction, agricultural engineering, irrigation, etc.

(c) An Editor to be appointed and located at the Amani Institute.

(d) The Journal to be issued bimonthly to begin with, and to contain advertisements for which payment is to be made on a scheduled scale.

(e) A separate Journal account to be kept, the Government of each territory to contribute towards the cost on the basis of the number of Journals supplied, with a minimum contribution.

(f) Each Government to indent for the number of copies required, these to be issued among the subscribers by the Department of Agriculture or other organisation in the receiving country at a charge, postage paid, of Shs. 10/- per annum. Complimentary copies to Departments of Agriculture and Institutions and persons in other countries, also to East African Trade and Information Office, London, to be issued direct by the Printer, according to list supplied by the Editor.

(g) Reprints of articles in the form of bulletins to be supplied at cost to Departments, as, and if, required.

(h) An Editing Committee to be appointed and to consist of the Director of Amani Institute (Chairman) when appointed, together with the Directors of Agriculture of Kenya, Tanganyika, Uganda, and Zanzibar, and any other contributing territories.

6. An approximate of Revenue and Expenditure is given hereunder:—

Expenditure.	Cost to begin with.
1 Editor (£600 x 20 to 720 x 30 to 840)	£600
1 Clerk-Typist (240 x 18 to 300)	£240
Passage and Leave Allowance, say	£250
Cost of stationery, etc.	£100
Travelling expenses	£200
Cost of publication of, say, 2,500 to 3,000 copies bimonthly	£1,250
Total cost per annum ...	£2,640

Revenue.	
1,500 subscribers at Shs. 10/-	£750
Advertisements £120 per issue	£720
Total revenue ...	£1,470

Leaving £1,170 or, say, £1,200 to be defrayed by different Governments.

It is not unlikely that use would be made of the services of the Editor in some other capacity at Amani, *e.g.*, as Librarian or Secretary, and he could also edit the scientific memoirs which it is hoped may in the course of time emanate from the Institute, which might in those circumstances be expected to bear the cost of part of the salaries and other expenses of the editorial service—thus reducing the amount to be contributed by the different Governments.

Against that cost, each Government would receive copies for circulation among its officers, and an organ valuable as a reciprocal issue to other countries, from which valuable agricultural literature is supplied free, besides the value of the Journal for the promotion of the Agricultural industry in its territory.

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(2) ECONOMIC PROGRESS OF TANGANYIKA TERRITORY

(Paper by the Director of Agriculture, Tanganyika—T.C.(C)Ag.10.) 1922 and 1923.

The order of the ten chief agricultural exports of the Territory (excluding wild rubber, for obvious reasons) in relation to their actual value, was now by no means the same as that in German times. The first, sisal, retained its priority; and (speaking of 1922) had reached one-half of its former output by weight. The place of the second, plantation rubber, had been taken by coffee, which now produced the one-fifth of the value of the ten chief exports previously given by the former. The third, hides and skins, partly through the entire lack of demand caused by the great decrease of prices in the world's markets, had descended to sixth place (ninth in 1921). Cotton, the fourth, had been maintained at the same place; and copra, likewise, remained unaltered at the fifth. The sixth, ground-nuts, had risen to the third place; and beeswax, the seventh, had descended to tenth. In 1913 coffee was as low as the eighth place instead of the second, with an export by weight almost exactly one-quarter of that in 1922. Simsim was ninth; now eighth. The tenth, ghee, like rubber, no longer appears among the first ten principal exports. In 1923 the order remained the same, except that groundnuts changed place with coffee, becoming second; and simsim rose to seventh place.

Of these products, all after sisal had moved up one place through the loss of rubber; so that, with the loss of ghee, we have so far mentioned only eight of the ten of our exports of principal value at that time. The products that had now found their way into the first ten were millet (mtama), with an export weight and export value in 1922 both more than eleven times those of 1913, the latter value having increased to more than sixty thousand pounds, bringing it to seventh place; and rice, with an export twice as great as in 1913.

Before the war, 63 per cent. of the total export value of agricultural and animal produce was divided between three products only: sisal, rubber, and hides and skins, with respective percentages of 30, 17½, and 15½. By 1922, the same proportion of that value was filled by four instead of only three such products, namely, sisal, coffee, groundnuts, and cotton, with respectively 22.3, 15.7, 14.7, and 10.8 per cent.; coffee, cotton, and groundnuts having actually increased from 2.6, 6.7 and 5.3 to the above proportionate values; in 1923 the similar percentages were: sisal 22.2, groundnuts 15.9, coffee 12.4, and cotton 10.7. The result is the attainment of a safer agricultural position.

Among minor agricultural products, through the unavoidable neglect of plantings, the export of kapok or silk cotton decreased from 52 tons in 1912 to 6 tons in 1921 but recovered to 30 tons in 1922.

Further, an increasing native interest was being taken in chillies, a small production of 12 cwts. in 1921 having become 188 in 1922. Of mineral products, mica was the chief, with an export of 32 tons worth £19,172 in 1923, or about three times that of 1922. The principal timber export was mangrove poles, valued at £2,925 in 1922 and £3,719 in 1923. Last, but not least of the non-agricultural exports important in the trade of the country, ivory had exports of 205 cwts., value £11,425, and 686 cwts., worth £51,393 in 1922 and 1923 respectively.

1924.

The value of the principal agricultural exports in 1913 was £1,296,105; in 1924, on the same price basis, it was £1,612,376 or 24 per cent. greater, and actually £2,329,861; showing a very considerable increase in the prosperity of the Territory. Of the first ten exports, the principal, sisal, retained its priority and had reached nearly nine-tenths of the last German output. Cotton was now second in value, having taken the place of the vanished plantation rubber industry. The third place was occupied by groundnuts, which then was sixth. Cotton was fourth in 1913; now coffee, with an output five times as great as the German production. Hides and skins had risen in recent years from sixth to fifth place, owing partly to the removal of the export duty and partly to better prices; it was third in importance before the war. Copra, with an increased production of 49 per cent. over that of 1913, had fallen from fifth to sixth. Simsim, now seventh, with an export more than four times as great, was ninth. The eighth and ninth places were taken, respectively, by rice and millet, which before the war were below the tenth place, and had since increased their export four and eight times. Beeswax was tenth on the list, having fallen from its position of great importance, seventh in 1913, and taken the place then occupied by ghee, but now like plantation rubber, absent from the list.

Before the war, 63 per cent. of the total export of agricultural and animal produce was divided between three products only: sisal, rubber, and hides and skins, with respective percentages of 30, 17½, and 15½. By the end of 1924, about the same proportion of that value was filled by four instead of only three such products, namely, sisal, cotton, groundnuts, and coffee, with, respectively, 24.7, 14.3, 13.8, and 13.5 per cent., cotton, groundnuts, and coffee having actually increased from 6.7, 5.3, and 2.6 to the above proportionate values.

The export of ghee, among minor agricultural products, already in 1922 above that of 1913, increased by the end of 1924 to 40 per cent. over that of 1913, assisted by the removal in 1922 of the prohibitive import tariff into Uganda and Kenya. The shipments of kapok or silk cotton decreased through the cause already mentioned from 52 tons in 1912 to 6 tons in 1921; but in 1924 equalled the 1912 production. Further, an increasing native interest was being taken in chillies, a small production of 12 cwts. in 1921 having become 188 in 1922, 10,382 in 1923, and 18,198 cwts. (worth £18,596) in 1924. Of mineral products, mica with an export of 57 tons valued at £27,638 in 1924, or about five times that of 1922, was surpassed by gold, owing to the development of the alluvial fields of Lupa River, whose export reached 7,577 oz. troy worth £30,319. The principal timber export, mangrove poles, had only a small value, £1,520. The shipments of ivory increased to 743 cwts., valued at £66,643.

1925.

The unfavourable season for annual crops brought about a rearrangement for the first four exports in that groundnuts was ousted from the group, being replaced as third by coffee, whilst hides and skins entered as fourth, in the place of the last-named, having risen from fifth and resumed its position of German times; in good seasons, however, groundnuts are likely always to be found in this group. The particularly encouraging circumstance, however, is the maintenance of its position (second) by cotton, in spite of its handicap of a bad season; and this is one of the strongest indications of the general suitability of the Territory to cotton-growing. After groundnuts, fifth and in the place of hides and skins, copra suffered a slight decline from its steady position; whilst rice and simsim, which notwithstanding the greatly varying conditions of season and external demand from year to year, maintain an export remarkable for its steadiness, did not move. Millet (although its export depends largely on the demand in Northern Africa and India) showed its susceptibility to unfavourable growing conditions by giving less than one-half of its export of 1924; and this, coupled with the sudden and unexpected rise in shipments of plantation rubber, caused its disappearance from among the first ten agricultural exports. On the other hand, the entrance of plantation rubber, virtually all Ceara, into this group (having multiplied its export value by 16 since the previous year) will not be maintained if prices continue to fall, although the discovery that this rubber has usefulness for special purposes may increase permanently its importance in the Territory. Other products that have moved above millet are ghee and cotton seed, these having undergone a significantly increased production, the former, owing to the greater demand and higher prices for a product improved by the efforts of the Veterinary Department, and the latter because of the stronger world's market. The last of the ten, beeswax (at present rather a forest than an agricultural product) with a lower export maintained its position in consequence of higher prices. Although they changed in that groundnuts disappeared from among them, coffee moving from fourth to third, and hides and skins coming up among them from fifth to fourth (as already mentioned), the first four export products in 1925 remained at about 63 per cent. of the total value, actually 65 per cent. Since the previous year, 1924, sisal and groundnuts have decreased from 24.7 to 22.9 and 13.8 to 5.9, respectively; whilst all the others increased as follows: Cotton 14.3 to 18, coffee 13.5 to 16, hides and skins 7.1 to 8.0.

Of minor agricultural products, kapok has maintained its increase to 86 tons, worth £4,900; whilst chillies, after their quickly developed output, suffered a reduction in their quantity and value to about one-eighth of those of the former year, namely, 2,474 cwts. and £2,610, the cause being the unpopularity of the crop, and the increased attention through higher prices to coffee in the chief area of their production, Bukoba.

The chief mineral products, gold and mica, maintained their changed relative position of 1924, exports being respectively 10,614 oz. troy, value £42,506 (similar to that of beeswax) and 52 tons (a decrease) worth about as much as the shipments of cotton seed, actually £31,532. The other principal non-agricultural export, ivory (738 cwts.) was worth about as much as the seventh agricultural export in value, simsim, at £71,094.

The figures on which the above information is based are given in the first table at the end of this paper.

Native and non-Native production for Export.

Details of this are presented in the second table at the end of this paper. It shows that, for the eleven principal agricultural exports, the non-native and native productions are about equal; but that the former owes its comparative position to sisal, the value of which is more than one-half of that of the whole non-native export of these products. Next in effect for this equalisation of native and non-native value of production for export are the higher value of the non-native coffee, as compared with native, and the sudden revival of the plantation rubber industry. In a temporary way, the native proportion was lessened by the unfavourable season (which does not immediately affect the output of sisal and coffee), the purely native productions, groundnuts and millet, being most seriously reduced in output by this.

TABLE I.

Tanganyika Territory. Principal Exports, 1913 and 1922-25.

1913.

Export.	Quantity. Cwts.	Value. £	% of total value.	Order.
Sisal	416,680	535,580	30.1	I.
Hides and skins ...	69,120	274,511	15.4	III.
Cotton	43,840	120,753	6.7	IV.
Copra	109,540	117,401	6.6	V.
Groundnuts ...	179,220	95,932	5.3	VI.
Beeswax	11,180	70,743	4.0	VII.
Coffee	21,180	46,563	2.6	VIII.
Simsim	29,520	20,407	1.1	IX.
Rice	15,420	8,717	0.5	—
Millet	18,210	5,498	0.3	—
Totals ...	913,910	1,296,105	72.6	—
Plantation rubber	25,740	309,195	17.4	II.
Ghee	6,656	15,400	0.8	X.
Cotton seed ...				

1922.

Export.	Quantity. Cwts.	Value. £	% of total value.	Order.	Value on par of 1913. £
Sisal	204,480	289,388	22.3	I.	262,829
Hides and skins	30,495	67,156	5.2	VI.	121,111
Cotton	30,887	140,750	10.8	IV.	85,075
Copra	95,420	89,633	6.9	V.	102,268
Groundnuts ...	250,360	190,553	14.7	III.	134,012
Beeswax ...	6,655	24,792	1.9	X.	42,110
Coffee	85,426	203,784	15.7	II.	187,804
Simsim	55,560	49,573	3.8	VIII.	38,408
Rice	30,523	26,417	2.0	IX.	17,255
Millet	200,517	61,898	4.7	VII.	60,540
Totals ...	990,323	1,143,944	88.0	—	1,051,412
Plantation rubber	186	381			
Ghee					
Cotton seed ...					

1923.

Export.	Quantity. Cwts.	Value. £	% of total value.	Order.
Sisal	256,900	367,228	22.2	I.
Hides and skins ...	41,370	117,554	7.1	VI.
Cotton	29,386	177,710	10.7	IV.
Copra	133,380	131,536	7.9	V.
Groundnuts ...	330,160	264,129	15.9	II.
Beeswax	6,039	24,758	1.5	X.
Coffee	80,937	204,987	12.4	III.
Simsim	88,700	75,527	4.6	VII.
Rice	57,721	41,517	2.5	VIII.
Millet	121,973	36,095	2.2	IX.
Totals ...	1,145,566	1.441,041	87.0	—
Plantation rubber				
Ghee				
Cotton seed ...				

1924.

Export.	Quantity. Cwts.	Value. £	% of total value.	Order.
Sisal	368,560	644,835	24.7	I.
Hides and skins ...	50,948	185,843	7.1	V.
Cotton	50,828	373,753	14.3	II.
Copra	162,500	178,194	6.8	VI.
Groundnuts ...	373,680	359,918	13.8	III.
Beeswax	8,497	44,666	1.7	X.
Coffee	105,222	352,529	13.5	IV.
Simsim	78,180	80,324	3.1	VII.
Rice	62,235	59,866	2.3	VIII.
Millet	158,332	49,976	1.9	IX.
Totals ...	1,418,982	2,329,904	89.2	—
Plantation rubber				
Ghee				
Cotton seed ...				

1925.

Export.	Quantity. Cwts.	Value. £	% of total value.	Order.
Sisal	365,520	688,451	22.9	I.
Hides and skins ...	53,225	240,165	8.0	IV.
Cotton	90,043	540,481	18.0	II.
Copra	152,460	160,800	5.3	VI.
Groundnuts ...	181,100	178,685	5.9	V.
Beeswax	5,858	42,755	1.4	X.
Coffee	120,186	481,055	16.0	III.
Simsim	67,920	71,561	2.4	VII.
Rice	60,921	62,232	2.1	VIII.
Millet	66,531	25,517	0.8	—
Totals ...	1,104,753	2,515,979	83.6	—
Plantation rubber	7,520	49,794	1.6	IX.
Ghee	7,658	33,770	1.1	
Cotton seed ...	86,980	32,560	1.1	

TABLE II.

TANGANYIKA TERRITORY. NATIVE AND NON-NATIVE PRODUCTION.

1925.

Export.	Non-Native production.	Percentage of total.	Native production.	Percentage of total.
	£		£	
Sisal	688,451	100	None.	—
Hides and skins ...	None.	—	240,165	100
Cotton	199,978	37	340,503	63
Copra	160,800	100	None.*	—
Groundnuts	None.	—	178,685	100
Beeswax	None.	—	42,755	100
Coffee†	157,309	33	323,746	67
Simsim	None.	—	71,561	100
Rice	None.	—	62,232	100
Plantation rubber ...	49,794	100	None.	—
Ghee	None.	—	33,770	100
Totals ...	1,256,332	49	1,293,417	51
Without sisal	567,881			

* Actually, very small proportionally.

† Bukoba non-native production estimated at 60 tons at £70.

(3) THE CULTURE OF COCONUTS IN SEYCHELLES AND VARIOUS ASPECTS OF AGRICULTURAL METHODS ADOPTED IN THAT COLONY.

(Paper by Director of Agriculture, Seychelles—T.C.(C)Ag.17.)

The culture of the coconut palm, which is supposed to be of South American origin, like all other species of the same genus, has long been considered as the staple industry in Seychelles. At one time it was neglected for the more profitable culture of vanilla which was intergrown with the palm; the consequence was that prior to the blow given to vanilla some 20 years ago by the synthetic manufacture of vanillin, coconut palms in Seychelles were for nearly half a century grown in mixed plantations of all sorts of trees which were then used as props for vanilla. The young trees set out for use as vanilla props soon became as tall as the coconut palms themselves and the whole mixed plantation formed a jungle which was certainly the cause of the coconut palms being attacked by many diseases and pests. Coconut palms are so hardy that they were able to resist this ill-treatment which would have been fatal to many other plants. Vanilla on the other hand, requiring shade for its growth and benefitting so largely from the mulch formed by coconut husks and leaves, was found to thrive under these conditions which, however, would have meant, in the long run, the complete destruction of the coconut palms.

For the last 15 years the coconut plantations have been cleared from jungle growth except cinnamon bushes, which are left in order to secure an annual crop of leaves used for distillation and worth about ₹25 a ton. It is fortunate however that cinnamon does not grow on the coral plateaux (the name " plateau " is given here to the flat portions of the coast where sea sand has been piled up) as these plateaux are the ideal spots for coconut culture. On the hill sides coconut palms also thrive owing to the easy percolation of rain water carrying food elements but the tendency is to retain cinnamon bushes there so as to have an intercalary crop and thus continue the traditional habit of growing two crops at the same time. It is however more and more realised nowadays that coconut palms do better without intercalary crops and that cinnamon should be relegated to the summits where the coconut is handicapped by permanent moisture and stiff soil. Under the shade of the coconut palms, which are now manured, it has been found that herbaceous plants like patchouli and ginger not requiring props are less injurious to the coconut and so the system of intercalary crops, so dear to many planters, has thus been maintained. It is not always easy nor useful to combat agricultural methods and ideas which have been handed down from generation to generation especially when planters who are mostly descendants from the old French planters of Mauritius and Reunion are not altogether ignorant and have acquired much practical knowledge.

It is however satisfactory that the agricultural methods are better adjusted now that herbaceous plants instead of trees are intergrown with coconut palms. The former policy was naturally the cause of the coconut palms being weakened and diseased nearly to the verge of extinction. Various forms of bud rot and bud decay,

little leaf diseases, stem bleeding, leaf spot diseases, scale insects, and lastly melitomma and rhinoceros beetles established themselves in coconut plantations and naturally passed from one tree to the other in most cases. It is for example quite surprising to find the melitomma bettle, which is a very shy insect, attacking coconut stems only and killing out a tree in full bearing and showing hardly any external sign except to a trained eye. This insect is indigenous in the Seychelles, North Madagascar, Senegal, and South America. As already stated the coconut palm is an introduced plant; hence the melitomma beetle formerly occurred on other plants in the Seychelles, later acquiring the habit of attacking the soft tissues of the coconut stem without ever being found on other plants. This has apparently been caused by intergrowing plants harbouring insects in coconut groves during such a long period of time that the life history of these insects has become modified. It is however important before arriving at conclusions as to this theory to find out whether in N. Madagascar or Senegal the melitomma beetle occurs on other plants. The same theory applies in all probability to other insects such as for example the scale insect known under the name of *Pinnaspis buxi* which is a scourge at the present moment and which evidently escaped from the indigenous screw pines *(Pandanus)* on which they were recorded more than 20 years ago. In many localities screw pines are left growing near coconut palms and another *pandanus* such as *pandanus utilis* is grown to make " Vacoa bags."

These remarks justify the desirability of giving much attention to the life history of insects when a new jungle is cleared more or less completely for the creation of coconut plantations or when intercalary crops are grown between the palms.. It is not easy in the tropics and especially in small colonies where little capital is available to fumigate or spray with insecticides plants of huge size amidst boulders and in the jungle. In the majority of cases one has to rely on the efforts of nature and look for remedial measures by means of natural parasites.

Another method of combatting pests in the tropics is to provide the plant under cultivation with manure which renders it more resistant to disease. This is becoming more and more evident in Seychelles where at last the practice of manuring has been taken up vigorously. Seaweeds are collected and even cropped on the reefs, cattle manure, guano, ash, chemical salts and last but not least, distillery refuse of cinnamon leaves are all used.

The occurrence of diseases and pests on coconuts has been found to be so closely connected with neglect of plantations that in many localities, the land is now cultivated, drained, terraced, green manured, and the trees are walled in to prevent the entrance of the melitomma beetle or its escape from attacked trees. Also in the coral islands the hard pan is broken through at great expense before manuring with phosphatic guano rich in organic matter. It has been realised that the occurrence of pests is an index of the state of neglect of plantations and as the crop of coconut palms varies very considerably from 10 to 200 nuts per tree per annum it is, after all, better to have to deal with one good tree than with 20 bad ones.

The state of neglect of plantations in former times, however, seems to have produced an unexpected result, viz., that a special strain of coconut palms has apparently been evolved which is

extremely hardy to adverse conditions of growth. Attempts to introduce new varieties of better strain or known to produce bigger nuts have not altogether been successful, the new trees being decidedly less resistant to local conditions and to harsh treatment; it is anticipated however that by natural cross-breeding the Seychelles strain of smallish nuts will eventually be improved and made to produce bigger nuts.

(4) GOVERNMENT CONTROL OF MARKETING.

(Note by the Director of Agricultural Economics and Marketing, South Africa—T.C.(C)Ag.19.)

A. Local Marketing.

The Union Government Division of Agricultural Economics and Marketing investigates the demands of the market, market tendencies, marketing systems and methods, marketing costs, and issues market advice and reports.

Some of the questions that arise in connection with local and overseas marketing relate to:—

Standardisation and grading.
Transportation.
Storage.
Services and agencies.
Middlemen's functions.
Credit demands and facilities.
Co-operation (Organisation, Registration, and Inspection of Co-operative Societies).

Although there is no specific control of marketing, except in the case of municipal markets, these services tend to bring about more economically efficient marketing. Standardisation, Grading and Inspection is at present only compulsory for exports, and the various state functions in this respect are to be found in the various acts mentioned in the Overseas Trade Section* of this memorandum.

The following Acts regulate local marketing:—

(i.) Public Auctions and Transactions in Livestock and Produce Act (No. 22 of 1925). An Act to regulate certain transactions in and the sale by auction of livestock and agricultural produce.
First published in Government *Gazette* Extr. No. 1493 of 27th July, 1925.

(ii.) Co-operative Societies Acts No. 28 of 1922 and No. 38 of 1925. To provide for the formation, registration and management of co-operative agricultural societies with unlimited liability, co-operative agricultural companies with limited liability and co-operative trade societies with limited liability. Act 38 of 1925. This Act amends Act 28/1922 in making provision for compulsory co-operation.

(iii.) Dairy Industry Act (No. 16 of 1918) as amended by Act No. 14 of 1926. To provide for the registration of dairy premises and the owners and occupiers thereof, for the marketing of dairy produce and the registration of marks thereon and generally for the regulation of the dairy industry.

* Not published.

(iv.) Agricultural Credits Act No. 40 of 1926 which makes provision for granting credits also for the disposal of crops.

B. Municipal Markets.

Municipal markets in South Africa are under the direct control of Municipalities to whom the monopoly has been granted under various Provincial Ordinances. Market Regulations are, however, submitted to the Provincial Administration for approval. The markets are under the supervision of Market Committees of Town Councillors—appointed annually. The Market Master is the business manager bound down by rules and regulations and the whims of the Council.

In the majority of cases Market Masters also undertake agency services in their official capacity. This system has been more fully developed in the case of the Durban Borough Market where the Market Master exercises a monopoly of agency business. The private market agent is not recognised, and producers selling through them are penalised with a high commission.

These markets serve as a source of general revenue for the Municipalities concerned.

Port Elizabeth Wool Market.

A feature of South African wool marketing is the successful system of catalogue sales held regularly by the Municipality of Port Elizabeth.

C. Maize and Perishable Products.

The Government Grain Elevator System has already in its first year of its operation proved of vital importance in the marketing of maize and the success of the first year's operations has justified an extension of the system.

Elevator receipts are issued by the Elevator authorities against which the banks are prepared to make advances to the holders.

D. Cold Storage.

The new Government cooling plant erected by the Railway and Harbour Administration in Table Bay Docks is the dawn of a new era in the marketing (especially export) of perishable products.

(5) THE CONTROL OF THE NATIVE COTTON INDUSTRY AND HOW FAR THE REGULATIONS IN FORCE FOR SUCH CONTROL IN THE SEVERAL COUNTRIES REPRESENTED ARE PRACTICAL AND ADEQUATE.

(Note by Mr. H. C. Sampson of the Empire Cotton Growing Corporation.—T.C.(C)Cot.1.)

The following countries have under their Cotton Ordinances issued regulations for the control of the native cotton industry: Uganda, Kenya, Tanganyika, Nyasaland, and Swaziland.

These regulations can be classified under the following heads:

1. The supply of seed for sowing.
2. The cultivation and care of the crop.
3. The control of insect and fungoid pests.
4. Marketing.

(The numbers given in brackets after the name of the country refer to the number of the rule in the latest cotton regulations unless otherwise stated.)

1. The Supply of Seed for Sowing.

In all British countries in East Africa the Government control the distribution of cotton seed for sowing (Uganda 2, 3. Kenya 2. Tanganyika 5, 6. Nyasaland 5, 6, 7).

In Uganda and Kenya the Government can requisition, without compensation, any seed required for sowing (Uganda 4. Kenya 3). In Tanganyika and Swaziland similar requisition can be made on payment (Tanganyika 7. Swaziland 5, 4). The Tanganyika Government can also control the variety of cotton grown by Europeans, being empowered to replace seed for sowing if that stocked by the intending grower for this purpose is found, for one cause or another, unsuitable (Tanganyika 8).

2. The Cultivation and Care of the Crop.

In Tanganyika Territory an attempt is made to fix the sowing season (Tanganyika 12). The same Government have issued rules to regulate the rotation of crops (Tanganyika 11). Kenya and Tanganyika have issued regulations regarding the proper cultivation and weeding of cotton crops (Kenya 8a, Tanganyika 13). In most of these countries the diseases of plants Ordinances give the Director of Agriculture permission to enter crops for the purpose of inspection.

3. The Control of Insect and Fungoid Pests.

In all countries concerned rules have been framed for the compulsory removal and burning of the old crop after the picking is completed (Uganda 6,7; Kenya 7, 8; Tanganyika 15, 16; Nyasaland 1, 2, 3; Swaziland 2; Northern Rhodesia Not. No. 115). Tanganyika has issued rules for reporting the outbreak of disease (14), and for keeping crops free from disease and insect attacks (13). All countries have issued rules usually under the Plant Diseases Ordinance prohibiting the importation of cotton seed from without. In certain cases this extends to seed of other plants which are known to harbour pests of cotton. Tanganyika has a rule permitting the removal and destruction of diseased plants (18), a rule for the destruction of diseased seed (10), and Kenya also has the same (Kenya 9). Kenya and Tanganyika have rules permitting the Director of Agriculture to remove plants, parts of plants, soil, etc. (Kenya 9, Tanganyika 17). Rules have also been made in most countries for restricting the movement of cotton from disease affected area (Uganda 4, Prevention of Diseases Ordinance, Kenya 5, 10; Tanganyika 9. Nyasaland Plant Pests and Diseases Ordinance. Cotton diseases rules 1-5).

4. Marketing.

Nearly all countries recognise three grades of cotton and have similar rules defining these. Each country has comprehensive rules governing marketing to suit local circumstances and to protect the native (Uganda 8-25, Kenya 11-25. Tanganyika 19-36. Nyasaland 13-19).

In addition to this there are certain rules governing ginneries which are designed to ensure the quality of seed for sowing.

These regulations, of which a summary is given above, refer, it should be noted, to a crop which has been or is being newly introduced into countries where there is very little settled agriculture, as it is known in more civilised parts of the world. In fact, many of the people who are now being encouraged to grow cotton are not true agriculturists at all. Many of them are, however, beginning to welcome the introduction of a crop which provides for them the means of earning money to pay their taxes and for such luxuries as they are beginning to require, but there is a grave danger that the encouragement of a single money crop, such as cotton, may in time lead to conditions which are not to the benefit of the ultimate success of this crop. This danger is all the greater in such parts where there is no real ownership of land and where natives can more or less at will clear new land to any extent for cultivation. Where the native poulation is dense this means the rapid denudation of forest growth for opening up new gardens for cotton-growing gardens, which are likely to be abandoned after the initial fertility of the land is exhausted. The native has not yet learned to look upon his cotton patch as part of his holding, if it can be called such, where he can grow his food crops in rotation with cotton. One usually sees that the food crop area is concentrated near the village, while the cotton lands are further afield. In some parts of the country one already sees signs of pressure on the land on account of the introduction of cotton and the promiscuous methods which are permitted the native in the taking up of land. It seems, therefore, that the time has come to look to the future and to attempt to settle the native on the land as a farmer and not merely a squatter, and to develop his farming in general, rather than to concentrate merely on one crop. Tanganyika cotton regulations appear to be the only ones which make any attempt to control the cultivation of cotton and bring it into line with the other crops which the native grows, and even here it seems possible that the means taken may defeat the ends intended. This refers especially to Rule 11, which, as far as can be seen, will encourage the native to continue to open up fresh and abandon old land, if the rule is in any way strictly enforced.

This matter is probably more a question of land policy and settlement rather than agriculture, but if such danger exists, as has been pointed out in this note, then it is for the agricultural authorities to bring this to the notice of their several Governments, if they have not already done so.

(6) THE CONSIDERATION OF THE QUESTION OF THE MOVEMENTS OF COTTON, SEED COTTON, AND SEED FROM ONE TERRITORY TO ANOTHER.

(Note by Mr. H. C. Sampson of the British Empire Cotton Growing Corporation.—T.C.(C)Cot.2.)

The regulations at present in force controlling the movements of cotton, whether seed, seed cotton, or lint from one part of East or South Africa to another are based very largely on the fear of introducing insect or fungoid pests, which may not at present occur. In addition to this, there is the necessity especially where cotton growing is a native industry, of regulating such movements in order to maintain the purity of the seed supply.

With regard to the former, the situation would be very much cleared if suitable arrangements could be made to put into effect the suggestions put forward in T.C.(C)Cot. 3. At the present time information about the presence and distribution of insect and fungoid pests is so scanty that the several countries have to protect themselves by enforcing stringent regulations to prevent the possible introduction of unknown pests. This action may seriously hinder the development of the cotton industry in many parts of East Africa, where the natural outlet for inland transport passes through territory controlled by another Administration. The boundaries between these different Administrations are often purely artificial and may run through the centre of a well-defined cotton tract where the same variety of cotton is grown and the same pests occur.

Another question which appears to need attention is the necessity of obtaining information as to what pests, whether insect or fungoid, can be carried in seed, seed cotton, or lint. It is possible that sufficient is known of the life histories of many such pests to be able to state definitely in what cases such danger exists.

The question of keeping seed stocks pure is one which needs consideration in the event of cotton being allowed to pass from one territory to another, as is frequently the case when tentative cultivation is started and there are no means of ginning the crop without transporting it elsewhere. This seems to imply that there should be closer co-operation between the Agricultural Departments of different administrations. If it is intended to attempt cotton cultivation in an area where the cotton harvested must be transported through another territory before finally being baled for export, then it seems clear that the variety of cotton used for such tentative cultivation should be the same as that grown in the country where it is to be handled. This would obviate any danger of contaminating the seed supply with seed of other varieties.

There is one aspect of the question which seems to need examination. In reports on cotton growing in some of these countries the seed from certain tracts has been condemned for sowing because the area where this has been grown does not produce the same length of staple as is produced in other tracts or climate where the same seed is used. This means that the soil in which the cotton is grown influences the quality and length of the staple. It does not, however, prove that the variety has deteriorated, and it seems that this is a matter for experiment. The experience of the writer of this note is that if such seed is again used in soils which are known to produce staple of good quality no deterioration is evident.

(7) NOTIFICATION REGARDING THE DISTRIBUTION, EXISTENCE AND OCCURRENCE OF INSECT AND FUNGOID PESTS.

(Note by Mr. H. C. Sampson of the British Empire Cotton Growing Corporation.—T.C.(C)Cot.3.)

At the present time there appears to be very little co-ordination between the different countries comprising East and South Africa in the matter of giving information regarding insect and fungoid diseases and a perusal of the various annual reports of the different countries shows that these do not give such information in sufficient detail.

In a new cotton country, such as East and South Africa is, there are possibly many pests which attack cotton, which are

indigenous to the country or locality; besides these, there is always the possibility of pests belonging to other parts of the globe being introduced. It is of great importance that the Agricultural Departments of these different countries should be notified of any such outbreaks, not only for administrative purposes, so that regulations to prevent the spread of such outbreaks can be enforced, but for the information of their entomologists and mycologists, whose work might be greatly assisted by any available information regarding the pests' life histories, how the disease may be spread, meteorological and ecological conditions which favour their spread and what chances there are for such spread.

Unauthorised reports of outbreaks may cause unnecessary alarm in adjoining territories, but if the Agricultural Department concerned were to issue a full report on this, which could be circulated to other countries, it might help all concerned. For example, last year the Government entomologist of a certain colony discovered the pink bollworm in an isolated district: it also occurred in the adjoining district of a neighbouring colony. From information collected by him, it was probable that this pest occurred north of that area on the native indigenous kidney cotton. It was only by chance that the Government entomologist was called to go up to this district to examine native cotton crops, when he discovered the infection. If it is true that the pest does occur to the north of this tract and that there was a danger of infection, then such information, if it had been furnished by one Government to the other, would have been of the greatest importance both from an administrative and entomological point of view. From an administrative point of view because the District Administrative officer had been doing his best to foster cotton cultivation in his district and with considerable success, when suddenly he had to tell the people that they were not allowed to grow cotton any longer: also from the point of view of movements of cotton from this area. If a full statement of the outbreak had been issued and circulated to other countries, stating what steps had been taken to prevent the possible spread of this pest elsewhere, where the area was situated, what were its boundaries and what possibility there was of its spreading by cultivation, it might quite well have allayed any alarm created by any unauthorised reports which may have been circulated.

Such reports also, following on such a Conference as this, where scientific officers concerned with cotton diseases have a chance to meet and confer, will undoubtedly lead to closer co-operation and collaboration in the future, especially if information concerning such pests is circulated as suggested in this note.

(8) SEED IMPROVEMENT: METHOD OF TESTING NEW AND IMPROVED STRAINS OF COTTON IN DIFFERENT PARTS OF THE COUNTRY.

(Note by Mr. H. C. Sampson of the British Empire Cotton Growing Corporation.—T.C.(C)Cot.4.)

It is taken for granted that, when new and improved strains of cotton have been produced on a central station, they will have to be tested to find out how far they are suitable for different parts of the country.

One of the greatest difficulties, which is experienced in arranging such tests, in countries such as those which make up East Africa, is to get people competent to grow and to pick the crops when grown.

For such tests one has to depend on European agency or native agency or a combination of both. Native agency by itself is not satisfactory, except in very few exceptional cases, and even in such cases frequent inspection would be necessary. European agency apart from officers of the agricultural services, means a Government official, a missionary, or, if there are any, a settler. The ordinary Government official is often quite willing to help, but being a touring officer, it means in practice that much of the supervision has to be left to native agency. More often than not, also, the Government official's knowledge of agricultural operations is strictly limited. In any case, it is a question of goodwill, as the supervision of such cultivation throws extra work on him. The missionary, also, is usually very similarly placed to the Government official: his knowledge of agriculture is limited and he is frequently away from his headquarters. Some of the Catholic missions might offer better scope, as they frequently have on their staff a lay brother, who is a horticulturist if not an agriculturist, but in their case they very often depend on the results of their labours for the funds with which to run the mission and extra work such as this would have to receive remuneration. The settler is usually too busy with his own crops to be of assistance.

It thus appears that, except in very occasional cases, agricultural officers must look after such cultivation. It is not clear how the District Agriculturist can do this without prejudicing his work as a touring officer. He may be able to co-operate with the District Administrative officer, but this is largely a matter of personal relationship, which may be severed at any time by leave or transfer. Further, District Agricultural officers are few and far between. In the whole of Nyasaland there are only two such, so here at any rate there is no chance of their being able to conduct more than one or two such tests at most. Where there are sufficient Agricultural officers to run agricultural stations, in addition to district work, it might be possible for those in charge of the former to run sub-stations within fairly easy reach of their headquarters.

The question of testing cottons is not merely a question of growing several strains side by side and taking the yield of each plot. Such trials must be repeated several times, and each plot of each series must be harvested separately. There are many other points which have to be considered. The land has to be stumped. The previous cropping of the land has to be considered. Newly cleared land, where there has been tree growth, is apt to affect the crop adversely and usually has a tendency to make the crop run to leaf. It is thus evident that definite and permanent sub-stations for such testing work should be instituted, especially as in many places these plots will have to be protected by fencing. The size and shape of plots is also an important question. Whether any work has as yet been done to ascertain this is not known.

The committee appointed to discuss the question might also record their opinion as to what records during the growing period of the crop should be maintained, indicating (1) those they think are

essential, and (2) others they consider advisable if staff permits. They might also discuss the question of how far the entomologist and mycologist can co-operate in regard to crop pests.

(9) SEED IMPROVEMENT: METHODS OF INVESTIGATING THE POSSIBILITIES OF NEW VARIETIES OF COTTON.

(Note by Mr. H. C. Sampson of the British Empire Cotton Growing Corporation.—T.C.(C)Cot.5.)

By new varieties it is taken to mean introduced varieties from other countries. It is presumed that everyone will agree that, in the first instance, investigation must be confined to agricultural stations, until such varieties have become acclimatised. These cannot be considered as merely comparative tests for yield. It is necessary to study in close detail such varieties: to find out whether these are true to a type: to find out the flowering habit and rate of flowering; to find out the amount of shedding; to ascertain the degree of immunity which these have from insect or fungoid diseases, etc., etc.; to note variations from the type, which sometimes show themselves when cultivated varieties of cotton are grown in a new environment, and, if necessary, to make selections with a view to obtaining strains which may prove more suitable to the conditions which prevail. In addition to this, there is the examination of the harvested cotton.

Then there is the question of the extension of this work in future years. It is more than probable that numerous selections will have to be made from any promising varieties, and in all probability it will be to these that one must look to produce strains suitable to the needs of the country. Here the question of selfing will come in.

It appears necessary that this matter should be fully gone into, in order to form an opinion as to what work should be started with the staff available for carrying it out.

(10) METHODS ADOPTED TO SECURE THE PURITY OF SEED DISTRIBUTED FOR SOWING PURPOSES.

(Note by Mr. H. C. Sampson of the British Empire Cotton Growing Corporation.—T.C.(C)Cot. 6).

The regulations which are in force to secure the seed supply are mentioned in T.C.(C)Cot. 1, and there is no need to repeat them here.

No other information is available as to the actual steps which are taken under these rules, and it is suggested that the Directors of Agriculture concerned might each prepare a note on the subject for circulation to delegates at the Conference.

This, however, is not merely a question of maintaining the purity of the general seed supply to the country. Where botanists and plant breeders are employed for the improvement of the cotton crop there must come a time, if it has not already arrived, when it will be necessary to take adequate steps to keep this supply of seed derived from the plant breeders' work pure and unmixed with the general seed of the country.

There are many difficulties to contend with, even in civilised countries. In America a system of what are known as " cotton communities " has been instituted with success in certain states. Whether such a method would be possible where cotton growing is a purely native industry is doubtful. Here one has to deal with small scattered areas belonging to a very large number of people. One has to deal often with a people whose knowledge of agriculture is strictly limited and whose methods of marketing are primitive. It is a difficulty in all countries where cotton is cultivated; and it would assist matters greatly if this subject could be dealt with by a strong committee at the Conference.

(11) THE CONTROL OF GINNERIES WITH SPECIAL REFERENCE TO THE SPREAD OF DISEASE.

(Note by Mr. H. C. Sampson of the British Empire Cotton Growing Corporation.—T.C.(C)Cot.7.)

It is an accepted fact that certain diseases of cotton of both insect and fungoid origin are conveyed by seed, and the question arises as to what action, if any, can be taken to lessen the risk of such spread. It is obvious that the source of the seed, viz., the ginning factory, is the place where any action desirable should, in the first instance, be taken.

The custom in those parts of Africa, where cotton is a native industry, is for the cotton to be purchased in grades. These are usually three in number, graded according to the cleanliness of the sample of seed cotton and amount of freedom from leaf. In Kenya and Tanganyika there are rules under the Cotton Ordinance which lead that seed of each grade of cotton ginned shall be marked and stored separately and that no dirty cotton shall be mixed with clean cotton, either before or after ginning. In Tanganyika, also, all seed has to be stored within the ginnery buildings and the owner of such seed is not allowed to retain this after March 31st of any year without written permission. It is presumed that the enforcement of this rule can be checked by the ginning figures supplied to the Director of Agriculture from each ginning factory, as these have also to report what quantities of each grade of seed cotton have been purchased in addition to the quantity of each grade ginned.

Beyond this there appear to be no regulations which will assist in checking any spread of disease. It seems that something could be done if the authorities had some control over the construction, plan, and arrangement of the ginning factory. Tanganyika has some rules for this purpose, but these seem to be designed from sanitary and fire protection points of view rather than for the protection of the quality of the ginned cotton and the prevention of seed mixing. The Indian Cotton Committee were so impressed with this aspect of the question that they made a specific recommendation that all ginning factories erected in the future should conform to a standard plan and that factories where roller gins are used laid down the dimension for the seed cotton platform, the distance between gins, and for separate entrances for seed cotton and exits for lint (para. 225). In this paragraph also (section K) it deals with the disposal of seed with special reference to seed infected by pink bollworm. This committee even went so far as to publish standard plans which they considered

all future factories to be erected should adopt. No definite regulations other than this were made about the disposal of seed, but this is hardly necessary under Indian conditions, where the seed will always find a ready sale as cattle food. In Africa, however, the matter is different. In many parts of the country the seed has no commercial value; some of it is certainly used for engine fuel to run the factory with, but the rest as often as not is left out in a heap in the open to rot. In Africa also, the saw gin is frequently installed and, unless the condenser is cleaned out thoroughly before ginning another grade of cotton, there is bound to be considerable mixing of seed with the next grade to be ginned.

It appears that this is an aspect of ginning which might be investigated to see what steps can be taken to ensure that the quality of seed for sowing is the best procurable, and that all factory precautions can be taken to prevent the spread of disease.

(12) TEMPORARY EXCHANGE OF TECHNICAL SPECIALISTS BETWEEN DEPENDENCIES.

(Paper by the Director of Agriculture, Tanganyika Territory. —T.C.(C)Cot.11.)

The purpose of this would be to make the widest possible use of the knowledge and experience of the different specialists and in turn to increase their own knowledge and experience under the larger variety of conditions that would be made available to them.

It is manifest that cotton investigations and cotton specialists would benefit by such a scheme. It should be a matter for interesting discussion as to whether it would be of important benefit to other technical agricultural officers such as agricultural economists and chemists, and mycologists and entomologists.

In any case it would be a necessary part of the scheme to ensure that such temporary exchange would not interfere with the continuity of the work and investigations of outgoing officers. The latter would be responsible for informing incoming officers fully of the details, purposes and intended development of their work, and these would be strictly responsible in an even greater degree for ensuring (as far as humanly possible) that no interference or interruption occurred in regard to that work.

Administrative arrangements and control for such a scheme would be simple. What is not as simple is the making of a plan to ensure that all participating dependencies obtained a fair share of the exchange, and that the scheme was not followed desultorily or was likely eventually to fall through. The formulation of such a plan is a matter for discussion. It is suggested as a basis that the scope of the duties of a technical officer should for the purpose include the obligation to spend a definite proportion (interrupted or not interrupted?) of each period of two consecutive tours (or period of four years) on exchange, and that each Director of Agriculture in the countries participating in the scheme should be made responsible for advising his Government in good time when the exchange period of an officer was due.

Not the least useful part of the work of those delegates at agricultural conferences occupying administrative posts would be to devise a working basis for the exchanges required in the period to

elapse between one conference and the next, thus facilitating the arranging of exchanges, and giving the officers concerned the advantage of knowing beforehand the place where their fresh experience was to be gained.

It is thought that officers would loyally follow up the work entrusted to them on exchange; and that there need be no fear that a desire would exist to take undue credit for simply continuing the work and observations devised and begun by another, or that there would be jealousy preventing the communication of observations or results not expected or foreseen when the work was devised.

(13) COTTON SEED SUPPLY AND CONTROL IN UNION OF SOUTH AFRICA.

(Specimen copy of agreement for season 1925/26).

AGREEMENT entered into BETWEEN the DEPARTMENT OF AGRICULTURE, to be represented by the CHIEF, TOBACCO AND COTTON DIVISION throughout (hereinafter referred to as the Department) on the one part, and Mr. ..... of.....(hereinafter referred to as the Grower) on the other part.

1. THE DEPARTMENT undertakes to supply the Grower with.....lbs. Cotton Seed of the Improved Bancroft variety from Special Seed breeding plots of the Government TOBACCO AND COTTON EXPERIMENT STATION, RUSTENBERG, at 3d. per pound.

2. THE GROWER undertakes to receive such seed and with it to plant a seed plot of ground which has been/or will be approved by the DEPARTMENT.

3. THE GROWER undertakes:—

(a) To grow no other cotton within a distance of 500 yards from the seed plot and to keep a radius of 500 yards from the seed plot clear of any volunteer cotton plants.

(b) To carry out any reasonable instructions by the Department regarding cultural methods to be followed in the raising of the crop.

(c) To cultivate and generally care for the seed plot to the satisfaction of the Department.

(d) To allow and facilitate inspection of the seed plot at any time during the existence of this agreement by any person deputed by the Department.

(e) To keep different pickings separate and mark accordingly, also to keep an exact record of all pickings.

4. In view of special care necessary in the ginning of the crop, the DEPARTMENT reserves the right of stipulating the Ginnery to which the crop shall be sent for ginning.

5. THE GROWER shall advise the DEPARTMENT of deliveries made and shall deliver at his expense the whole of the crop resulting from the seed plot at the Ginnery stipulated, packed in woolpacks clearly marked with:—

(a) The GROWER'S initials.

(b) The words "Government Seed."

(c) The number of the picking.

6. THE DEPARTMENT reserves the right to supervise the ginning and to decide the time and manner in which the crop shall be ginned and delinted.

7. THE GROWER shall bear the cost of ginning, delinting, and bagging of the seed.

8. The lint produced on the seed plot shall be the sole property of the GROWER.

9. Immediately ginning is completed, the DEPARTMENT shall hold sole and entire control of all the seed produced on the seed plot, and shall, in its own discretion, regulate the selling and despatching of the seed.

10. (a) THE GROWER shall receive payment from the DEPARTMENT for all multiplied seed sold less ½d. (one halfpenny) per pound which shall be deemed accrued to the DEPARTMENT in payment of expenses incurred and services rendered.

(b) THE DEPARTMENT shall fix the selling price of the multiplied seed.

11. THE GROWER shall be entitled, free of charge, to one-tenth of the seed produced by himself from Government seed, and he shall pay all transport expenses in connection therewith.

12. THE DEPARTMENT reserves the right at any time to cancel this agreement should the GROWER fail to conform to the clauses laid down herein.

13. This Agreement stands for the season 1925-26 only.

(14) LEGISLATIVE MEASURES IN THE CONTROL OF INSECT PESTS AND PLANT DISEASE.

(Paper by T. J. Anderson, Entomologist, Kenya.—T.C.(C)E. & M.1.)

The importance of agriculture to the Colony of Kenya is well recognised and, as it is the basic industry, it is logical to assume that nothing should be left undone to place it on a sound and permanent basis and to protect it from pests and diseases.

Development, especially in recent years, has been rapid: for example, between June 1920 and June 1925 the acreage under cultivation had more than doubled.

Within a comparative short time, 400,000 acres of bush or grass land have been put under crops; the natural grass has been pastured and acres of forest have been cleared.

All these operations have to some extent relieved pests and diseases from the restrictions imposed by their natural associations and have so disturbed the normal balance which nature had striven to maintain through long years that pests and diseases have become much more prominent and are responsible for increasing damage and consequent loss.

Again, during the Colony's development, thousands of consignments of plants and seeds have been imported from overseas, bringing with them the risk of the introduction of new pests and diseases.

It is common knowledge that commerce may not only increase the number of pests but may convert a pest, not especially injurious in one country, into a plague in another and this because the new habitat may be more favourable or perhaps more so because its hereditary enemies are not at the same time introduced.

For protection against the pests and diseases which are indigenous and also to prevent the introduction of others, legislation was introduced. For the purpose of this paper the subject will be dealt with under three heads:—

1. Regulations governing the Importation of Plants.
2. Regulations governing Plantation Inspection.
3. Plant Quarantine.

I. Importation of Plants.

In the Colony there is a very wide range of climate—from tropical through subtropical to temperate and even arctic. There are, therefore, conditions under which nearly all crops, fruits, and plants of the world can be grown as well as all kinds of vegetables, conditions which are unrivalled perhaps anywhere in the world.

But, going hand in hand with these conditions, there are opportunities for the establishment and perpetuation of all the pests and diseases of every clime.

The costly experience of other parts of the world shows that the war against imported pests and diseases may run up a huge bill and may make all the difference between profit and loss.

In the past there may have been some misunderstanding and there may have been a feeling that personal rights were being interfered with or even withdrawn but it is now being more widely recognised by settlers, planters, nurserymen and gardeners that any importation of plants whatsoever from overseas brings with it the risk of the introduction of a new pest or disease; also that, as no inspection is perfect certification and inspection do not eliminate that risk but merely reduce it, it is in their own interests to comply with the regulations, to watch carefully the plants which they import and at once report any pest or disease which may be found.

The Diseases of Plants Prevention Ordinance, of April 15th, 1910, made it lawful for the Governor, from time to time, to make, alter or repeal regulations for all or any of the following purposes:—

(a) For regulating the importation into the Colony of any plant affected or liable to be affected with insect pest or plant disease.

(b) For preventing the introduction or spread of any insect pest or plant disease to which plants are liable.

In the Ordinance the term "plants" includes growing trees, plants or portions thereof such as cuttings, buds, seeds, fruit, and vegetables.

The first regulations under this Ordinance were issued in October, 1910, by Sir E. P. C. Girouard, who was then Governor. These regulations were in force until 1921, when they were amended. In July, 1924, they were further amended and are the regulations, which with some slight additions, are now in force.

When the regulations were first drafted in 1910, it was not anticipated that the community, and consequently the plant imports, would increase as they have done. Knowledge of the great diversity of our agriculture and its importance in our economic life has rapidly increased. Modern means of transportation have brought about a greater dispersion of injurious pests and diseases. Hence, the regulations have been altered, from time to time, and in all probability will be again altered, so that they may be kept up to date and may afford the best protection possible.

It is laid down definitely in the regulations (para. 14) that all plants and seeds imported into the Colony shall be examined by an inspector and, as it is useless to have such work done in a spasmodic way, and as all plans for plant protection by inspection should be made so that they will continue unbroken for a long period of years, qualified officers of the Department of Agriculture are gazetted as inspectors in addition to the Plant Import Inspector who is stationed at the Port of Entry.

The Plant Import Inspector examines all consignments which arrive at the Coast. In addition to these large numbers of packages of plants and seeds—especially seeds—arrive by parcel post and are examined at the G.P.O., Nairobi, by one of the officers already mentioned.

Any package or parcel containing any imported plant or seed must bear on the outside thereof a label on which shall be set forth (a) the full name of the variety and place of origin of such plant or seed, (b) the name and address of the nursery or person supplying such plant or seed.

Ordinary flowers or vegetable seeds, garden plants, etc., do not require to have a permit although such a permit, first obtained, greatly facilitates inspection.

For certain plants or seeds a permit must first be obtained from the Director of Agriculture. The usual method is for the applicant to write to the Director of Agriculture asking that a permit be granted for the importation, stating number and varieties and the source of origin. This application is scrutinised by the entomologist and mycologist and may be passed, altered or have some special conditions attached. A permit on the prescribed form is then made out at the Head Office, a copy being sent to each of the following: The applicant, the Plant Import Inspector, Entomologist, and Mycologist. Thus as complete a record as possible is kept of all such importations.

Those plants and seeds for which a permit is necessary are detailed in the regulations and are as follows:—

(a) Peach stones—Peach yellows.

(b) Apple and pear stocks or cuttings. The term "stocks" shall include young rooted plants for budding or grafting purposes; woolly aphis; various fungi.

(c) Potatoes—wart disease *(synchytrium endobioticum)*. Permission, however, to import seed potatoes from the United Kingdom will be granted if:

1. The variety thereof is included in a list published by the Ministry of Agriculture of England and Wales of varieties immune from wart disease.

2. The consignment thereof is accompanied by a certificate, under the Seal of either of the Boards of Agriculture of England, Scotland, and Ireland that no case of wart disease has been reported within a radius of five miles from the place where the tubers thereof were grown, and

3. Such consignment is accompanied by a declaration on oath by the consignor thereof that all the tubers of such seed potatoes were grown in the place mentioned in the certificate.

(d) Citrus trees and citrus fruits other than citrus fruit grown on the islands of Zanzibar and Pemba—Citrus canker.

(e) Gooseberry and currant. Stocks or cuttings—Mite—American mildew.

(f) Sugar Cane—Borer; mosaic; general fungoid diseases.

(g) Blackthorn and barberry—Rusts.

(h) Onion and Leek Seed—Smut.

(i) Vines and vitaceae—Phylloxera.

(j) Tea seeds or plants.

For general reasons, as tea planting is comparatively new to the Colony.

(k) Coffee plants whether living or dead, coffee beans or coffee (except roasted coffee beans, ground coffee and coffee extract). This prohibition shall not extend to:—

(1) Coffee plant, coffee beans, and coffee imported for transit through the Colony, which may be so imported subject to the following conditions:—

(i) Coffee plants, coffee beans, and coffee must be securely packed in cases or in double bags of substantial sacking, separately sealed to the satisfaction of the Director of Agriculture and the Commissioner of Customs.

(ii) Every case or cover containing such plant, bean, or coffee must be sealed or stencilled in a prominent position thereon by a Customs Officer showing the country of origin and the place of importation, and no such case or cover shall thereafter be opened within the Colony.

(iii) Should any case or cover containing such plants, beans, or coffee become so damaged in course of transit through the Colony as to render it possible for any such plant, bean, or coffee to escape therefrom, it may, at the discretion of the Director of Agriculture, be destroyed. No compensation shall be payable in respect of such destruction.

(2) Trade samples of coffee beans or coffee, not exceeding one half pound in weight, imported through the Department of Agriculture.

Any coffee plant, coffee bean or coffee imported in contravention of this clause shall be liable to be detained and destroyed or otherwise dealt with as the Director of Agriculture may direct.

These regulations with regard to the importation of coffee have been purposely made stringent because since coffee growing was started no pest or disease from any other part of the world has been introduced and, as we have a considerable number of indigenous pests and diseases which depreciate the yield and which in some instances are difficult to control, every measure possible must be taken to prevent the introduction of others.

(l) Cotton seed except in transit for re-export. Permission, however, to import cotton seed will be granted if:—

(1) Imported into the Colony for use therein through Kilindini, Mombasa, or any other port or place of entry as may be approved by the Director of Agriculture on the application of the importer.

(2) The consignment thereof is accompanied by a certificate under the seal of the Department of Agriculture of the country from which it is consigned to the effect that it has been fumigated within one month before consignment to the Colony or that it is free from pest or disease.

All cotton seed unaccompanied by a certificate as specified in sub-clause (2) hereof shall be delivered by the importer or his agent to an inspector for fumigation at the port or place of entry (or elsewhere as may be directed by the Director of Agriculture) and shall be removed by the importer or his agent immediately after such fumigation.

Any cotton seed imported in contravention of this clause may be detained and destroyed or otherwise dealt with as the Director of Agriculture may direct.

Such, then, are the regulations governing the importation of plants and seeds into the Colony and Protectorate of Kenya.

To summarise briefly:

1. Certain plants and seeds are prohibited entry, viz.: hemp narcotics.
2. Others, on account of their liability to carry certain serious diseases, which at present are not known to occur here, are allowed in only under permit from the Department of Agriculture.
3. Others not included in the above two categories should preferably be obtained from reputable sources of supply.
4. All consignments, whether admitted by permit or not, or whether accompanied by a certificate or not are still liable to inspection, treatment or destruction.

The regulations may, at first sight, seem cumbersome or even redundant, but since Plant Import Inspection was inaugurated in 1908, as far as we are aware at present, no insect pest has been introduced and only two diseases, viz., mosaic on sugar cane and die back of apples and pears.

Before 1908, two insect pests have been introduced, namely, Red Scale and Cottony Cushion Scale on citrus.

II. Regulations Governing Plantation Inspection.

An Inspector may enter upon any lands, nurseries or other places where he has reason to believe there is any pest or disease or where he has reason to believe there is any plant or seed which may prevent the proper control of any pest or disease.

A Plantation Inspector was appointed and took up his duties in July, 1924.

His duties comprise (a) actual inspection work, (b) the collection of information required for the improvement or alteration of the regulations, (c) the enforcement, when necessary, of the clauses of the regulations dealing with the control of pests and diseases, (d) the acquiring, for the Scientific Officers of the Department an index of the prevalence of pests and diseases and the loss caused thereby.

As with Plant Import Inspection so it should be with Plantation Inspection, such work ought to continue unbroken over a long period of years and ought not to be spasmodic as is apt to be the case where one unit only is available.

Since his appointment, the work has consisted, almost entirely, of the Inspection of Coffee Plantations, for which there are special regulations.

" 19. An Inspector may enter upon any lands on which he has reason to believe that any coffee bush is growing, for the purpose of inspecting the same.

20. Whenever an Inspector shall consider that any coffee bush is infested with any pest or disease or that the condition of any coffee bush or the state of any land on which any coffee bush is growing is such as may give rise to any pest or disease, he may:—

(a) If such land is occupied, require, in writing, the owner or occupier thereof to take such action with regard to such land or any coffee bush or bushes thereon as he may consider necessary or advisable to control or eradicate any such pest or disease or to prevent the spread of any pest or disease, or

(b) If such land is unoccupied or appears to such Inspector to be unoccupied, treat or destroy any or all coffee bushes thereon, as to him may seem necessary or advisable.

21. (a) Whenever under the powers conferred by Regulation 20 an inspector shall require an owner or occupier to take any particular action with regard to any land or any coffee bush thereon he shall specify a period as may seem reasonable to him within which such action shall be completed.

(b) If such owner or occupier shall fail to carry out such requisition such Inspector may cause such treatment or destruction to be carried out at the expense of such owner or occupier.

(c) Service of such requisition sent by post to such owner or occupier (or to the manager or person appearing to the Inspector to be the manager of such land) shall be deemed to be good service upon the owner or occupier.

(d) If such owner or occupier to whom such requisition is made shall fail to complete such action within the time so specified, he shall be guilty of an offence and shall on conviction, be liable to a fine not exceeding Shs. 2,000 or in default of payment thereof to imprisonment of either description for a term not exceeding three months.''

III. Quarantine Regulations.

The word '' quarantine '' is usually associated, in the minds of many people, with something unpleasant, but plant quarantines are as a rule only means of regulating the movement of plants.

The Director of Agriculture may prohibit the movement within the Colony of any plant or seed which is diseased or which he may suspect of being diseased or likely to spread disease and he may prohibit for any prescribed period the growing of any plant or crop or variety thereof which he may consider likely to hinder the prevention of the spread and the proper control of any disease or pest.

Until recently, there has been no need to have any such quarantine but with the spread of mealy bug on coffee and the presence of mosaic disease on sugar cane in one of the sugar growing areas, the following notices regarding the movement of these plants, in certain areas, have been gazetted:

'' No person shall move or cause to be moved any coffee plant from any of the districts of Ngong, Kyambu, Ruiru, Thika, or Fort Hall to any other part of the Colony or Protectorate: provided that nothing in this rule shall be construed as prohibiting the movement of coffee plants within or between the districts mentioned in this rule.''

'' In view of the existence of mosaic disease on a number of farms in the Nyanza Province I hereby prohibit the movement of sugar cane or any part thereof from any farm situated within limits defined in the schedule hereto.

Provided this prohibition shall not apply to: (a) sugar cane in transport direct to a mill for crushing. (b) sugar cane of the variety ' Uba.' ''

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